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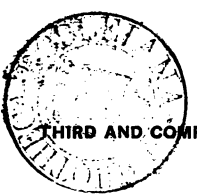

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AUTHOR'S PREFACE

TO THE SECOND EDITION.

THESE Memoranda are intended to refresh the memory of the practitioner on a subject which is not brought under his notice so frequently as many other departments of medicine. They are especially adapted to show at a glance the treatment to be adopted in each particular instance of poisoning to which a medical man is liable to be summoned.

There seems reason to fear that the crime of slow poisoning is more extensively practised in the present day than is generally believed. The study of the following pages will, it is hoped, put the physician on his guard; and prevent his attributing to natural disease symptoms due to the villainous administration of deadly drugs.

HENRIETTA STREET, CAVENDISH SQUARE.

EDITOR'S PREFACE.

THE present edition of Dr. Tanner's 'Memoranda on Poisons' is in some respects almost a new book. It was, as will be seen by the Author's Preface to the last Edition, Dr. Tanner's object to furnish the practitioner with a useful guide to his duties in cases of poisoning. Experience has, however, shown that the book is more useful to the student than to the practitioner; and, with a view to render it still more valuable to the former, it has in great measure been remodelled. Whilst, therefore, due attention has been paid to what might be called the clinical aspects of poisoning, its chemical bearings have been more closely attended to; and the more important and reliable tests have in each instance been given, as have also the more important processes for separating poisons from organic admixture. Sick of the old and clumsy classification of poisons into Irritants, Narcotics, and Narcotico-Irritants, the editor has endeavoured to form some more rational groups of toxic agents.

These groups are, it is true, quite provisional; and they are somewhat similar to those adopted by Dr. Guy in his admirable text-book on Forensic Medicine. They have, however, been worked out independently, whether they be worth anything or no. Briefly they are these :—

Corrosives.—Simple Irritants, Mineral, Vegetable and Animal. — Irritant Gases.— Specific Irritants Mineral, Vegetable, and Animal.—Neurotics: subdivided into Narcotics, Anæsthetics, Inebriants, Delirants, Convulsives, Hyposthenisants, Depressants, Asphyxiants,—and Abortives.

Such a grouping is far from perfect; but it would be impossible to have anything worse than that still in general use. It is with the hope of rendering this little volume more generally useful these changes have been made: a reason at all times all-powerful with its lamented Author.

A. S.

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TOXICOLOGICAL MEMORANDA.

INTRODUCTION.

CHAPTER I.

DEFINITION AND MODE OF ACTION OF POISONS.

TOXICOLOGY (τοξικὸν poison, and λόγος discourse,) is that branch of medical science which treats of the nature, properties, and effects of poisons.

It appears scarcely possible to give any definition of a poison which will bear a critical examination; insomuch that some have preferred to deal with the evil effects of any substance, that is *poisoning*, rather than with the substance itself, the so-called *poison*. Most medicines are poisonous in improper doses; and even common salt (chloride of sodium) has caused death.* Dr. Guy defines a poison to be any substance which, when applied to the body externally, or in any way introduced into the system, without acting mechanically, but by its own inherent qualities, is capable of destroying life. A cherrystone

* In the year 1839, a young lady residing in the north of England took about half a pound of salt to rid herself of worms. Very soon afterwards she began to suffer from all the effects of an irritant poison, with general paralysis; and in spite of the use of the stomach pump and of antidotes, she died in a few hours. Dr. Christison has recorded two somewhat similar cases.

may cause death by becoming arrested in the vermiform appendix, and thus producing peritonitis; boiling water may cause death also; but neither are poisons: the one acting mechanically the other by its heat merely.

Any substance which can injure the health or destroy life is regarded as a poison, if given with the *intent* to do mischief. The words of the statute (1 Vict. c. 85, sec. 2) are—"Whoever shall administer, or cause to be taken by any person, any poison, or other destructive thing, with intent to commit murder, shall be guilty of felony, and being convicted thereof shall suffer death." Sometimes poisons are administered, not for the purpose of destroying life, but of causing some slight injury or annoyance. An Act passed in March, 1860 (23 Vict. c. 8), provides for the punishment of a guilty person under these circumstances. If life be endangered, or "grievous bodily harm" result, the administrator may be found guilty of felony, and sentenced to penal servitude for a term not exceeding ten years. If the intent be only to "injure, aggrieve, or annoy," the crime is reduced to a misdemeanour, punishable with an imprisonment for not more than three years.

In accordance with the Pharmacy Act certain substances have been defined as poisons within the meaning of the Act, so as to put some restriction on their sale to the public.

Poisons may be introduced into the body in various ways and in various forms. Thus, they may be administered by the mouth or by the rectum, and they may be given in the form of solids, liquids, or gases, uncombined, or mixed with various matters. Some agents are more readily absorbed than others; whilst some textures permit of absorption taking place more quickly through them than other

tissues. Thus, the most diffusible poisons prove most rapidly fatal, especially when introduced directly into the circulation by a wound in a vein, or when they are injected into the subcutaneous connective tissue. Their action is also speedy when applied either in a gaseous state to the pulmonary air-cells, or as a fluid to that of the stomach or intestines. The serous membranes, too, possess an activity of absorption almost superior to that of the mucous membranes; while absorption through the skin is slow, on account of the cuticle. Poisons taken into the stomach when that viscus is empty, necessarily act much more speedily than when it is full. It is remarkable that the agents which most affect the nervous system do not appear to act at all when applied directly to the brain or trunks of nerves. There are also some poisons, as that of the viper, which, although most deadly when introduced into the blood through a wound, are harmless when swallowed.

The effects of poisons may be considered as *local* and *remote*.

The *local* effects are mainly of three kinds, viz., *corrosion*, or chemical decomposition, as is seen in the effects of the strong mineral acids and alkalies; *irritation*, or *inflammation*, varying from simple redness, in its mildest, to ulceration and gangrene, in its most severe degree, such as may result from the use of corrosive sublimate; and *a local specific effect*, produced on the sentient extremities of the nerves, as is felt on the local application of prussic acid, aconite, &c.

The *remote* effects are those influencing organs remote from the part to which the poison has been applied. These may be either common or specific: *common*, such as the constitutional indications of inflammatory fever, however produced; *specific*, like the constitutional effects

of opium over and above its local influences in relieving pain, &c. Various narcotic poisons produce but little local change, though their remote effects are very remarkable. For example, belladonna, in whatever way it may be introduced into the system, paralyses the ciliary nerves and so causes dilatation of the pupil. Many substances have both a local and remote action, as is well seen in the influence of cantharides upon the part to which they are applied, and their remote effects upon the urinary organs.

These remote effects must be induced by one of two modes, or, as some contend, by both: by *absorption*, that is, by the passage of the poisonous particles into the blood; or by *sympathy*, that is, by an impression transmitted through the nerves.

In the present day every one allows that poisons may become absorbed, and that, provided they produce poisonous effects at all, they are absorbed, in whatever way they may have been applied to the body. But it is sometimes asked, Is this absorption necessary for their action? The following evidence may be briefly noticed as in some degree affording an affirmative answer to this question. Magendie divided all the parts of one of the posterior extremities of a dog, the artery and vein being reconnected by quills, so as to preclude the possibility of the effect being conveyed by the nervous filaments supplying the coats of the vessels; on applying a portion of upas tieuté to a wound in the foot, the symptoms of poisoning occurred, and death took place in ten minutes. If the veins leading from a poisoned part be tied, the arterial and nervous communication being complete, the symptoms of poisoning do not occur. Mr. Blake introduced some prussic acid into the stomach of a dog, through an opening in its parietes, after he had

gatured the vessel entering the liver (the vena portæ, hich, directly or indirectly, receives the gastric veins); no ffect ensued until the removal of the ligature, within one inute of which proceeding the poison began to act. And stly, not only has prussic acid been discovered in the lood of an animal which perished in thirty-five seconds, ut, in some experiments made by Mr. Erichsen, in a case f extroversion of the bladder, prussiate of potass was found a the urine within one minute of its being swallowed on an mpty stomach.

The chief argument in favour of a *sympathetic* or direct erve action, is the almost instantaneous manner in which ome poisons act; fatal effects occurring, it is said, before ufficient time has elapsed to allow of absorption. It has, owever, been proved that the round of the circulation ay be accomplished much more speedily than has been nagined. Thus, the ferrocyanide of potassium injected into ie jugular vein of a horse was discovered throughout the ntire venous system in twenty seconds; and Mr. Blake as inferred from his experiments that a poison may be iffused through the body in nine seconds. It may there- ore be concluded that in most instances poisons act by eing absorbed and conveyed with the blood to the different rgans which they impair, or the nerve centres which rule ie functions of these; some paralysing the heart when they ach it, some affecting the brain or the spinal cord, some opping the play of the lungs, and others acting upon the ifferent glands. Nevertheless, in view of the extreme apidity with which death is brought about in a few stances, the possibility of a direct shock to the nervous stem causing death must not be overlooked.

The action of a poison may be variously modified, and ie mod*ifying circumstances* must be carefully taken into

consideration in the formation of a prognosis and in suggesting a line of treatment.

The *quantity* or *dose* is the most important of these; many substances which are deadly in large doses being exceedingly useful as remedies in small quantities; such are prussic acid, opium, digitalis, arsenic, &c. Then again, the *mechanical* and *chemical* state of aggregation are all-important; a solid being usually much less active than a fluid or a gas, and a pure substance much more active than one mixed with insoluble materials. Even more important is the chemical constitution of the poisonous agent; as already pointed out, poisonous effects result from absorption of the poisoning body and absorption implies solution; the more soluble, therefore, the compound is, the more speedy are its effects, whilst compounds insoluble in water or any of the juices of the body are inert. It is not, however, enough that the substance be insoluble in water; it must be so also in the gastric juice, or it may give rise to characteristic symptoms. Thus, calomel is insoluble in water, yet it is a powerful medicine; orpiment is insoluble in water, yet, when swallowed, it may give rise to symptoms of arsenical poisoning, and so on. As already pointed out, the mode in which the poison is introduced into the body is of great consequence in estimating its effects. Then again the *mental* and *bodily condition* of the recipient must be taken into account. Thus, in excited maniacs doses of medicines may be given without producing any effect which in ordinary individuals might give rise to serious consequences. The bodily condition, especially as influenced by habit, is still more important. It may be broadly stated, that by gradually increasing the dose of a substance ordinarily poisonous, in course of time *enormous quantities* may be borne without producing

immediate ill effects. This is especially seen in the practice of opium eating and smoking, and in a less degree in arsenic eating, as practised in Styria. The latter instance is, however, contrary to the usual rule; for whereas with vegetable substances, such as opium, the dose requires to be constantly increased to keep up the effects, with minerals, the contrary seems to be the case, especially with antimony and mercury, which cannot be long given without danger to the recipient.

CHAPTER II.

DIAGNOSIS OF POISONING—DUTIES OF THE PRACTITIONER.

THE chief characteristics of poisoning mentioned by author of repute are, that the symptoms commence suddenly after taking any substance or fluid into the stomach, the individual being in a state of health; that they increase steadily, and are uniform in their nature throughout their course; and that they prove rapidly fatal. There are many exceptions to these rules. Thus, if the stomach be loaded the appearance of the symptoms will often be delayed some few hours. Sleep, according to Dr. Christison, may retard the action of some agents; so that if a person fall asleep soon after swallowing arsenic or strychnia, for example, no effect may ensue for four or five hours. Intoxication will mask the effect of narcotics. Again, the individual poisoned may possibly be suffering from disease, and an agent may be given which will only aggravate existing symptoms. The fact must not be forgotten that sometimes a poisonous draught *is substituted* for a harmless medicine. And

lastly, after a poison has manifested its effects the symptoms often remit for a time.

When poison is administered with a criminal intent it is generally in such a dose as to take immediate effect, although this is by no means necessary, as there are numerous substances which accumulate in the system, and when given in small and repeated quantities, ultimately prove fatal. It must also be remembered that there are many diseases, as malignant cholera, internal hæmorrhage, &c., which commence suddenly, and rapidly run to a fatal termination. In inflammation of the stomach or intestines the symptoms often set in suddenly, and might be mistaken for poisoning; such is also the case in intestinal obstruction, and especially in ulceration and perforation of the bowels. So also in organic diseases of the heart, where the symptoms may have remained latent for some time, death often occurs suddenly from syncope. The diagnosis of the effects of irritant poisons is not so difficult as it is in the case of narcotics or other neurotics, where the symptoms are very similar to those produced by apoplexy, epilepsy, tetanus, convulsions, or disease of the brain.

Generally speaking, a person may be supposed to be suffering under the effects of a poison, if soon after taking food or drink, he be seized with violent pain, vomiting, disorder of the alimentary canal, and convulsive movements: or if he be attacked under the same circumstances with vertigo, delirium, or great drowsiness. It must not be forgotten, however, that poisons may be introduced into the body, not only by the mouth, but also by means of suppositories and enemata, or in females by vaginal injections, or by inhalation, or by subcutaneous injection, or through the true skin after the removal of the cuticle.

Should death ensue, the presumption of unfair play will of course be strengthened by the discovery of post-mortem appearances similar to those known to be produced by the poison from which the person apparently suffered.

The post-mortem appearances, however, except in a few instances, are not very characteristic; nevertheless they may be of great *negative* value in proving that a certain poison has not been administered, or that the patient died from the effects of disease. Two symptoms, excessive lividity of the body and early putrefaction, formerly supposed to indicate death by poison, are now known to frequently follow other modes of death. It may nevertheless be remarked, that the appearances after death which may be produced by poisons are, in one great class, the signs of inflammation of the alimentary canal; in another, the signs of congestion of the nervous system; and in a third, a combination of the two.

The detection of poison in some of the food which has been left untaken or in the matters vomited would seem to be conclusive evidence of the administration of poison; but it is to be recollected that designing persons have mixed noxious materials with food or rejected matters, in order to feign poisoning, or to cast unjust imputations upon others.

When called to a case of supposed poisoning during life the practitioner's duty is two-fold. His first aim must of course be to preserve life (see next chapter); his second, to forward the interests of justice. But if he reaches the spot too late to save life his duties are undivided, for he has but to see that justice is done, and in order that there be no failure it is important that all his observations be committed as speedily as possible to writing. He should inquire the *time* at which any substance was last taken,

the nature of the symptoms, the hour at which they commenced, and the precise time at which death occurred. He must take possession of any food, medicine, vomited matters, urine, or fæces which may be in the room; and, if possible, he is to seal them up, in new and clean vessels, duly labelled, for examination. Then the position and temperature of the body are to be observed, the appearance of the countenance, the presence or absence of rigor mortis, with the nature and warmth of the apartment, the situation of any marks of violence, and the condition of the inside of the mouth and gullet. In addition to the ordinary rules to be observed in conducting post-mortem examinations in cases of suspected poisoning, something more must be done, with a view to preserving portions of the body for subsequent examination. The alimentary canal is the most important organ to be thus secured, and it should be removed in separate portions. A double ligature should be passed round the œsophagus in the chest, and the duodenum a few inches below the pylorus should be secured in like manner; by cutting across the gullet and gut between these ligatures, the stomach may be removed without any danger of spilling its contents. It is best to open the stomach after it has been introduced into the receptacle prepared for it, so that its pathological condition may be noted as early as possible. Another ligature should be tied low down in the rectum, and the intestines removed and introduced into a separate vessel prepared for them, and then examined like the stomach. Sometimes it may be necessary to remove the gullet in like fashion. As much blood as possible should be saved for the chemist, and a portion of the liver, if not the whole organ, should also be secured. When everything has been tied up, the jars *should be sealed*, numbered, labelled, and initialled, to

prevent subsequent confusion and to facilitate identification. In women, the vagina, uterus, and ovaries must be inspected. The brain, spinal cord, and thoracic viscera ought likewise to be examined, and portions of the spleen, kidneys, and muscles should be reserved for analysis. No antiseptic or preservative fluid is to be used. When possible it will be best to make the autopsy within twenty-four hours after death; taking care to make the examination patiently, thoroughly, and with a mind free from any bias. Poison may be found in a body, and yet a question may arise as to its having been the cause of death. Hence in these investigations every organ of the body is to be examined, in order to learn whether any disease has existed sufficient to account for the fatal result.

Any suspicious conduct on the part of those surrounding the poisoned individual should be carefully noted. Acts of this kind arrange themselves in three heads, as occurring before, or during the fatal illness, or after death. With the first category the practitioner has ordinarily nothing to do, but his attention to those coming under the second and third is often of essential service to the ends of justice. The kind of acts will suggest themselves to every one, and need not be further referred to here.

CHAPTER III.

DUTIES OF THE PRACTITIONER—TREATMENT OF POISONING.

WHEN the practitioner is called in to a case of poisoning while yet there is life, he must set himself to preserve it in whatever way he best can; in this of course he must be guided by circumstances, but several broad rules may be

laid down. All have one end, but the order may be varied. That is best which is readiest, the grand rule being to lose no time. Most of the modes of treatment come under one or other of the three following heads:—1. GET RID OF THE POISON. 2. STOP ITS ACTION. 3. REMEDY THE MISCHIEF IT HAS DONE.

1. *To get rid of the poison* is ordinarily the first thing to be done, but not always. To do so when the poison has been swallowed two means may be employed: *vomiting* or the *stomach-pump*.

The latter is one of the most certain means we possess of emptying the stomach; and by means of it this viscus may be washed out, and the antidote, if any be known, administered. In speaking hereafter, however, of the treatment to be adopted in each particular instance, it will be seen that there are some cases, as poisoning by corrosives, in which this instrument cannot be used; as it might not only cause laceration of the tissues, but even perforation of the œsophagus or stomach. It is hardly necessary to mention that in all cases a certain tact is required in its employment; the tube having, on more than one occasion, been introduced into the trachea, and the lungs injected with water, &c. It is a good rule also to withdraw less fluid than is pumped into the stomach.

Supposing, however, that this instrument is not at hand, or that it is an improper occasion for its employment, recourse must be had to vomiting, natural or artificial. Vomiting is, in many instances, one of the first and most important signs of poisoning, especially by irritant substances. When such is the case, it is only necessary to foster the tendency by copious draughts of lukewarm water; but if there be no vomiting and the stomach-pump be not at hand an *emetic must be given*. Of these remedies perhaps there is

not one which can be generally used with so much advantage as the sulphate of zinc in scruple doses; for not only is it more rapid in its action, but its effects are less depressing than those of any others. This last recommendation will appear the more desirable when we remember that the absorption of poisons is promoted by all lowering measures; and consequently, bleeding, the exhibition of tartarised antimony, and the administration of drastic purgatives, ought to be avoided. In poisoning by opium and other narcotics, the sulphate of copper in eight or ten grain doses will often excite the stomach to act when other emetics have failed. Ipecacuan wine (six or eight drachms) is a useful agent in many cases; or if a warm stimulating draught be needed a scruple of powdered ipecacuanha, with the same quantity of the sesquicarbonate of ammonia, may be administered in a wineglassful of water. In the absence of these, mustard proves an excellent substitute; a teaspoonful or two being given in warm water, and frequently repeated. Even common salt may be used with good effect. Vomiting may also be excited by tickling the fauces, as well as by the free administration of warm water or of hot greasy water.

When the poison has been applied locally, to prevent its absorption, a ligature must be applied between the trunk and the wounded part, as near the latter as possible; while the deleterious substance is to be removed by free incisions and plentiful washings. Sucking by the mouth or by cupping-glasses may also be employed.

2. *To stop the action of the poison if it cannot be readily and immediately removed.*—The means whereby this is effected is ordinarily the administration of an antidote. As no universal antidote is known, the treatment will of course vary with the substance taken. This will

be fully explained when speaking of each particular poison.

An antidote, according to Orfila, should possess the following properties:—It should be capable of being taken in a large dose without danger; it should act upon the poison, whether liquid or solid, at a temperature equal to or below that of the body; its action should be quick; it should be capable of combining with the poison, though shielded by the gastric juice, mucus, bile, or other substances contained in the stomach; and lastly, it should deprive the poison of its deleterious properties.

Antidotes mostly operate by forming harmless chemical combinations, or by producing insoluble compounds, and thus preventing or delaying absorption. In most cases they have no effect upon the constitution; but some may be looked upon as a kind of counter-poison. Thus, the antagonistic action of opium and belladonna seems fairly made out, and we might perhaps include under this head chloroform, as in some degree, an antidote to strychnia.

Dr. Garrod has described a series of experiments in which he employed purified animal charcoal as an antidote. Dogs, rabbits, and guinea-pigs were the animals experimented on; while the poisons consisted of large doses of opium, belladonna, aconite, nux vomica, arsenic, and other drugs. They were given without mischief when sufficient animal charcoal was administered simultaneously, or, in some instances, before the peculiar effects of the destructive drug were developed. This substance seems to act in a great measure mechanically, but it has also a power of absorbing alkaloids which may render it useful. Such substances as magnesia and gruel are sometimes given with the view of protecting the walls of the stomach, with [redacted]btful benefit.

3. *To remedy the mischief done, and obviate the tendency to death.*—Unfortunately, in a great number of instances, too long an interval has elapsed between the exhibition of the poison and the time when the first-mentioned indications can be fully carried into effect; for, as before implied, if absorption has taken place, direct antidotes will be of little avail.

Our object must then be to palliate the symptoms as they arise, as well as to neutralise the *effects* of the poison on the constitution, by remedies of an opposite character. Thus in poisoning by depressing agents and narcotics, or such as destroy the nervous force, all lowering measures must be avoided, and agents used which will exert a contrary effect, as stimulants, cold affusion, galvanism, &c. The shock to the nervous system must also be taken into account, and appropriate remedies employed to aid it in rallying.

Thus direct injection of liquid ammonia into the veins has been found successful in the treatment of snake bite in Australia, by Professor Halford and others.

Claude Bernard has shown the importance of particularly attending to the way in which the poison destroys life. For example, curare paralyses the motor nerves, puts a stop to all motion, suspends respiration, and so brings on suffocation; yet by keeping up artificial respiration for a sufficient length of time, life may be preserved till the poison is eliminated and the danger over. Strychnia attacks the sensitive portion of the nervous system; but if the external excitement, which perpetually provokes reflex action, and thereby brings on fatal convulsions, be guarded against, recovery may ensue. A frog, poisoned by strychnia, rapidly dies if frequently excited; whereas left perfectly quiet under a bell-glass, it will, *cæteris paribus*, recover.

Lastly, we must endeavour to promote the elimination of the poison from the body, by exciting the excreting functions; for which purpose, in poisoning by arsenic, after the stomach has been well emptied, Orfila has proposed the employment of diuretics, because it has been found that this poison, like most others, is carried off in large quantities by the urine.

CHAPTER IV.

DETECTION OF POISONS.

THE detection of a poison is, in many instances, no easy matter; it should not, therefore, be rashly undertaken, except by one well skilled in the minutiæ of the processes to be adopted; but, on the other hand, there are so many points of practical importance which may be noted by the practitioner in charge, that his attention should be specially directed to these. The exact determination of the cause of death will depend partly on the symptoms noted during life and on the appearances found after death. These come within the province of the ordinary practitioner; on the other hand, the special physical, chemical, and physiological portion of the inquiry should be referred to the expert. In a book of this scope it is impossible to give full details with regard to these last, but a brief sketch may be useful.

The physical examination, say of the contents of the stomach and intestines, should commence with noting the smell, colour, and general appearance of the matters submitted for examination. The odour, for instance, may be useful in indicating the presence of prussic acid, of alcohol,

of opium, or of phosphorus. The colour may indicate the presence of salts of copper, of fragments of cantharides, &c. The general appearance may give some clue to the mode of introducing the poison, the kind of food or drink used to conceal it, &c. Seeds of poisonous plants may be found: this is especially the case in India, where the seeds of datura are frequently used for criminal purposes; or the poisonous substance may have been administered in such quantity that a portion of it may at once be secured for analysis. This not unfrequently happens in poisoning by arsenic. It is not enough to employ the naked eye in examining these suspected matters; a hand lens of some power should be used; in this way characteristic crystalline forms, botanical peculiarities, and such like, may be made out.

Still these are merely introductory to the most important part of the research, which ought to be undertaken systematically, especially if the quantity of material to be operated on is small. Most frequently the matters to be examined are mixed, some soluble, some insoluble; but there may also be submitted for analysis portions of the pure substance. The object of the analyst is to obtain the substances which he has to examine chemically in as pure a condition as possible, so that there may be no doubt about the results of his testing; also, of course, to separate active substances from those that are inert, all being mixed together in the stomach and alimentary canal. Again, in dealing with such fluids as the blood, or the tissues of the body, their natural constituents must be got rid of before the foreign and poisonous body can be reached. There is this difficulty further to contend with: that some of the most poisonous of substances are of unstable composition and readily altered by chemical reagents; to this group

belong many vegetable and most animal poisons. These, therefore, must be treated differently from the more stable inorganic compounds. With an inorganic poison we may destroy all organic materials mixed with it, trusting to find it still recognisable after the process; not so with an organic substance: that must be separated by other than destructive means.

When the mixture submitted for examination consists of bodies perfectly soluble and perfectly insoluble, simple filtration may suffice to secure their separation; but this is rarely the case, some colloidal material being ordinarily mixed with the crystalloid, and the plan of separating them by *dialysis*, as proposed by Graham, not being altogether successful. When the substances looked for are volatile, destillation may be employed to secure them in a state of purity; in this way prussic acid is separated; but in the case of the poisonous alkaloids other means must be adopted.

I. In the separation of such an alkaloid as strychnia, for example, the suspected material is first of all acidulated by one of the weaker mineral or stronger vegetable acids (hydrochloric acid is best), and the whole carefully heated over a water bath. After a time this mixture is to be filtered, and the filtrate well washed with boiling distilled water, and the filtered fluid subjected to evaporation. When dry the substance is to be rubbed up with distilled water, and again filtered; this process to be repeated until a tolerably pure product be obtained. This is next to be neutralised by hydrogen sodium carbonate, or bicarbonate of soda, and the freed alkaloid taken up by rubbing or shaking it with chloroform or ether, and the whole set aside in a well-corked tall test tube. Finally, the ether or chloroform containing the alkaloid is to be *removed* by a pipette and allowed to evaporate spon-

taneously, when the alkaloid will probably be left behind in a state fit for testing. This process is a modification of that invented by Stas, in following out the case of the Count Bocarmé.

II. For the destruction of organic matter in the search for an inorganic poison, such as arsenic, a process introduced by Fresenius and Von Babo is commonly employed. Its essentials are as follows: The organic matter is to be reduced to as fine shreds as possible, and mixed with about one-eighth of its bulk of pure hydrochloric acid. This is to be heated, and, as it boils, from time to time crystals of potassic chlorate are added, until the solids are reduced to a straw-yellow fluid. This is next treated with hydrogen sodium sulphite, or bisulphite of soda, until a distinct smell of sulphurous acid is given off, after which sulphuretted hydrogen is to be passed through the fluid, concentrated if necessary, for some hours, thus throwing down most metallic poisons in the form of sulphide. This precipitate is to be collected and further tested.

When exceedingly small quantities are dealt with the microscope is of use, and the plan of subliming alkaloids and examining their crystals under the microscope, introduced by Guy and Helwig, will be found very useful. The shape of crystalline poisons is a valuable means of determining their identity; arsenic and antimony may thus be readily distinguished, as may other well known substances.

The spectrum has not yet been applied to toxicological research, although it has been employed to determine the existence of a blood stain.

CHAPTER V.

CLASSIFICATION OF POISONS.

THERE is nothing more difficult in toxicology than to give a satisfactory classification of poisons, insomuch that some have fallen back on the no-classification, or natural history system, and grouped poisons as mineral, vegetable, and animal, according to their source. In despair of achieving anything better, a modification of the old and well-known system is here followed, poisons being classed as Corrosives, Irritants (Simple and Specific), and Neurotics; the latter group is, however, further subdivided, something in the same way as that adopted by Dr. Guy. The group of corrosives should comprehend all which by contact destroy the bodily textures, and so occasion death. These same substances, when diluted, may be incapable of destroying the tissues directly, but may do so by setting up inflammation; these, with certain others having like effects, would form the group of simple irritants. They kill by virtue of their secondary effects on the constitution. But some substances, like arsenic, are not only capable of inducing local inflammations, with their secondary effects, but are also possessed of certain specific and well marked properties differing in each case. These are *specific irritants*.

Neurotics comprehend all poisons whose effects are mostly referable to the nervous system, necessarily a most diverse group, which we are not yet in a position to minutely analyse. Some, however, act mainly on the brain, some on the spinal cord, some on certain nerves only, or on the basomotor system of nerves; some act it is hardly possible to tell how.

There was an old group of *septic* poisons; to this might still be referred certain noxious gases, such as sulphuretted hydrogen; or were it made to include all poisons acting directly on the blood, it would include the still more dangerous gas, carbonic oxide.

The following table exhibits these subdivisions, and some of the poisons contained in each:

Corrosives	Strong Mineral Acids	Sulphuric. Nitric. Hydrochloric.
	Vegetable Acid	Oxalic.
	Alkalies	Strong Alkalies. Alkaline Carbonates, &c.
Simple Irritants		The above diluted. Lime. Zinc. Silver, &c.
Specific Irritants		Arsenic. Mercury. Antimony. Phosphorus. Iodine, &c.
Neurotics		Opium. Prussic Acid. Chloroform. Belladonna. Aconite. Strychnia. Conium. Tobacco, &c.

Irritant poisons give rise to pain in the stomach and bowels, faintness and sickness, and purging with tenesmus. The evacuations are often tinged with blood, the pulse is feeble and irregular, and the skin cold. Many of the substances of this class, from irritating the tissues with which they come in contact, produce a severe burning sensation in the mouth and œsophagus, as well as in the stomach. The *degree of* local destructive action produced will of course

vary in proportion to the amount of the vehicle with which the noxious agent may be diluted. Irritants cause death by inducing collapse or convulsions, or by exciting severe inflammation; or, after a variable interval, by leading to stricture of the œsophagus. The diseases which most resemble the action of irritants are, malignant cholera, severe diarrhœa, colic, gastritis, enteritis, rupture of the stomach or intestines, and obstruction of the bowels, mechanical or otherwise.

The symptoms of apoplexy, epilepsy, and uræmia bear a resemblance to those caused by some of the poisons of the neurotic class. Others give rise to delirium with spectral illusions or convulsions. Sometimes there is tetanus, sometimes coma or syncope. Diseases of the brain and spinal cord, likely to be confounded with these, are often very insidious in their progress, and hence may suddenly give rise to suspicious symptoms. The history, mode of attack, &c., will generally negative any suspicion of poisoning.

I.—CORROSIVES.

CHAPTER VI.

THE CONCENTRATED MINERAL ACIDS.

THE first division of the Corrosives consists of the Strong Mineral Acids. In this chapter we have to review the effects, &c., of the acids commonly encountered, which are Sulphuric Acid, Nitric Acid, Hydrochloric Acid, or a mixture of two or more of them.

SULPHURIC ACID (*Oil of Vitriol*).—This heavy, oily-looking liquid is met with in two states, concentrated and diluted; and being extensively employed in commerce and manufactures is much more frequently used as a poison than the other mineral acids. Many infants and young children have been poisoned by it; occasionally also men, under the influence of drink. The acid is not unfrequently thrown over the person, either to disfigure the features or to destroy the clothes. The parts of the body with which it is brought into contact are stained at first of a white, and afterwards of a dark-brown or black colour. The smallest fatal dose of concentrated acid recorded, in the adult, is one drachm; but recovery has taken place after as much as two ounces. But it must be understood that the acid proves fatal mainly by its power of corrosion, so that a small *dose* of the concentrated acid is more dangerous

than is a much larger dose of it in the dilute form. The average period at which death occurs is from sixteen to twenty-four hours; but on the other hand, death may not occur for months, and may only follow the organic changes induced by cicatrisation following the swallowing of the acid, or the malnutrition following its destructive action on the coats of the stomach.

Tests.—It is not within the province of these Memoranda to treat of the various processes by which poisons are to be detected; for to make a trustworthy analysis requires the skill of a professed chemist, whose assistance should be allowed in these medico-legal investigations. Where the character of a dead man or the life of a supposed criminal is at stake there must be no chance of error. The ordinary tests will, however, be briefly described, if only to help the physician to treat the case more satisfactorily than he could do by merely guessing that an irritant or narcotic had been employed:

Concentrated sulphuric acid is usually a brownish-coloured liquid, which chars or corrodes wood or other organic matter brought into contact with it, and when mixed with water gives out heat. When diluted, its presence may be thus detected:—

1. The liquid is known to be acid by its action on litmus paper.

2. Add to a portion of the suspected liquid a few drops of nitric acid, and then a solution of nitrate of barium; a white precipitate (sulphate of barium) will fall if sulphuric acid be present. This test is extremely delicate; for although other acids yield a precipitate on the addition of nitrate of barium, yet as such deposits are all soluble in nitric acid the previous addition of this acid will prevent their formation.

3. The precipitate should next be collected, dried, and reduced with charcoal by the blow-pipe flame to the condition of barium sulphide. This, when treated with a drop of hydrochloric acid, gives off sulphuretted hydrogen, known by blackening paper dipped in acetate of lead solution.

To examine a piece of cloth stained with this poison it is only necessary to boil it in distilled water and then apply to the liquid the barium test as before.

NITRIC ACID (*Aqua fortis, Red Spirit of Nitre*).—This substance has been employed as a poison for upwards of four centuries. Like the oil of vitriol it is found in commerce in a concentrated and in a diluted state. Cases of poisoning by it are rare. It produces a yellow stain on the skin. Two drachms is the smallest quantity which has destroyed life; but less than this would probably prove fatal, if it produced much corrosion about the windpipe. Death has occurred from it, in one hour and three quarters; the average would be within twenty-four hours.

Several cases ending fatally have followed the inhalation of the fumes of this acid, probably by inducing very extensive inflammation of the lung.

Tests.—The concentrated acid may be known by its orange-coloured irritating fumes, and by its action on copper, tin, or mercury.

1. When poured on copper-filings, effervescence takes place, a red acid vapour is given off, and a green liquid remains (solution of nitrate of copper).

2. In a diluted state it is detected by its acid reaction; by no precipitate being obtained by nitrate of barium or by nitrate of silver, proving the absence of sulphuric and hydrochloric acids; further, by neutralising the liquid with potass, evaporating it, and then procuring crystals of nitrate of *potassium*, in the form of lengthened fluted prisms,

which are permanent in the air. These crystals may be powdered and moistened with strong sulphuric acid, when a colourless acid vapour (nitric acid) will be evolved. Or the powdered crystals may be mixed with an equal bulk of fine copper filings, moistened with water, and treated with a few drops of sulphuric acid; when ruddy acid fumes will be given off.

3. Other tests for nitric acid are, α, its action on morphia, which it turns red; β, its action on green iron sulphate, which it blackens; γ, a trace of it along with sulphuric acid gives with narcotine a blood-red colour; and finally, δ, along with hydrochloric acid it dissolves gold.

HYDROCHLORIC ACID (*Muriatic Acid, Spirit of Salt*). —Not more than half a dozen cases of poisoning by this acid have occurred in the last fifteen or twenty years in this country. In May, 1859, a woman sixty-three years old was admitted into King's College Hospital within three-quarters of an hour of swallowing half an ounce of the strong acid. She had burning pain in the throat and stomach, vomiting of brown shreddy matters, and great prostration. Death occurred in eighteen hours, from the corrosive action of the poison. This is the smallest dose which has been known to prove fatal.

Tests.—The concentrated hydrochloric acid of commerce is of a yellowish colour, it fumes in the air when strong, and produces dense white fumes with the vapour of ammonia.

1. It may be identified by boiling with black oxide of manganese; chlorine being given off, which is known by its odour, colour, and bleaching properties.

2. When diluted, its presence is ascertained by nitrate of silver causing a dense white precipitate (chloride of silver *The chloride is distinguished* from other salts of silver b

α, its insolubility in nitric acid, and in caustic potass; *β*, by its being soluble in ammonia; and, *γ*, by its melting and forming a horny mass when dried and heated.

MIXED ACIDS.—These acids being used for commercial purposes when mixed—*the nitro-muriatic* (aqua regia) to dissolve gold, and the *nitro-sulphuric* (aqua reginæ) to dissolve silver—might occasion their being employed as poisons. *Sulphate of indigo*, which consists of a solution of indigo in strong sulphuric acid, has proved fatal in cases where it has been accidentally taken.

Symptoms, Treatment, &c.—The *symptoms* produced by the mineral acids are much the same in all cases. There is violent, burning pain in the mouth, œsophagus, and stomach, commencing *immediately*. The burning is followed by retching and vomiting of a dark-coloured liquid with shreds of mucus, and portions of the mucous membrane of the œsophagus or stomach. The inside of the mouth is shrivelled and more or less corroded, unless the agent has been given in a spoon or otherwise passed over the tongue to the back of the fauces. The outside of the lips and mouth will probably present the stains characteristic of the acid used. There is great thirst, difficulty of swallowing, and impeded respiration. The bowels are confined; the urine scanty or suppressed. Next succeeds great exhaustion, the pulse becomes quick and feeble, and the skin gets cold and clammy. The countenance is anxious and expressive of great suffering; death speedily occurs, the intellectual faculties remaining clear to the last.

These acids may prove fatal without entering the stomach by causing asphyxia, the chink of the glottis becoming closed by swelling of the fauces, &c. They have sometimes been administered by the vagina, rectum, &c., and have poured into the ear during sleep.

Where recovery takes place from their immediate effects there is always fear of death resulting at the end of one or two years from stricture of the œsophagus, and even at an earlier period, unless proper treatment is adopted. Occasionally one of the secondary effects of sulphuric acid has been profuse salivation.

The *post-mortem appearances* are the following: The body may have a healthy appearance. Usually there are stains about the mouth, fingers, and wherever the cuticle has been reached by the acid. The inner surface of the mouth, fauces, and œsophagus, is usually white and corroded, or dark brown and shrivelled, the mucous coat being easily detached. The epiglottis and glottis are usually swollen. The gullet resembles the mouth in most respects. The outer surface of the stomach and intestines is very vascular, that of the former being sometimes corroded and occasionally perforated. The stomach is sometimes contracted, sometimes distended with gas, and contains a thick, dark-brown fluid; its inner surface has a charred, blackened appearance, the mucous membrane between the rugæ being of a scarlet hue. The pylorus is mostly contracted; while the inner coat of the duodenum and small intestines presents a similar appearance, in a less degree, to that of the stomach. When perforation occurs it usually takes place posteriorly, and the edges of the rent are softened. The escaped matters may have acted on the adjacent viscera.

According to Casper, after poisoning by sulphuric acid the bodies resist putrefaction for some time, owing perhaps to the acid neutralising the ammonia of decomposition. It may be the same with the other mineral acids.

Treatment.—Bicarbonate of soda, or calcined magnesia, *or the carbonate of* magnesia, should be immediately

given, mixed in milk or any mucilaginous fluid; the doses being continued at short intervals, until it may be inferred that the acid is neutralised. In the absence of these remedies substitutes may be found in chalk, whiting, soap and water, or the plaster of the apartment beaten up with water. Oleaginous and mucilaginous fluids, as olive oil, linseed tea, barley water, milk, gruel, &c., may be freely given, either alone, or as the vehicles of the antidote. The success of this treatment will depend upon the promptitude with which it is adopted.

The stomach pump should not be employed; the disorganized and softened state of the gullet and stomach, rendering them excessively liable to perforation.

Should the larynx be affected and the breathing impeded, tracheotomy must be at once had recourse to.

After a sufficiency of the antidote has been given the use of mucilaginous diluents must be continued for some time, and the subsequent treatment will be that for gastro-enteritis. Great benefit will be derived from the use of oily enemata.

The external parts which have been injured by the acid should be well bathed with soap and water, and treated like burns.

CHAPTER VII.

THE CORROSIVE VEGETABLE ACIDS.

OXALIC ACID (*Acid of Sugar*).—This is one of the most important poisons with which we have to deal. From its cheapness and well known properties it is frequently made use of in cases of suicide, while from its resemblance to

Epsom salts it has on several occasions been taken in mistake for that medicine. The smallest dose which is known to have proved fatal is one drachm, which killed a boy æt. sixteen in eight hours. Taylor relates the case of a woman, aged twenty-eight, who was found dead one hour after swallowing three drachms of the crystallized acid. Christison mentions an instance in which one ounce destroyed life in ten minutes, and another case where the same quantity killed a girl in thirty minutes. One example has been recorded where a fatal result ensued probably within three minutes of the acid being swallowed.

The poisonous properties of the *Binoxalate of Potash* (Salt of Sorrel, Essential Salt of Lemons) are due to the oxalic acid it contains. This salt, which exists in the leaves of the wood sorrel (Oxalis acetosella), is sold to bleach straw, remove ink-stains, &c. It is very cheap; is almost as powerful as oxalic acid itself, and gives rise to the same kind of symptoms; it has been taken for the purpose of suicide, as well as in mistake for the bitartrate of potash, or cream of tartar.

Oxalate of lime exists in considerable quantity in the leaves and stalks of the common edible rhubarb (Rheum Rhaponticum). It can hardly be considered poisonous.

Symptoms.—The effects of poisoning by oxalic acid are peculiar. When the dose is large (half an ounce or more) and the solution concentrated, it proves very rapidly fatal. It produces a hot burning sensation in the fauces and œsophagus in the act of swallowing, severe burning pain in the stomach, and in most instances immediate vomiting. The vomited matters are strongly acid, of a dirty green or black colour, and consist of the contents of the stomach with altered mucus and blood. The remaining symptoms are a sense of constriction or suffocation, lividity of the

countenance, great prostration of strength, feeble pulse, cold clammy perspirations, and convulsions, which speedily terminate in death. When a smaller quantity has been taken, much diluted, its corrosive properties are weakened or destroyed, but the nervous symptoms, as cramps and numbness, may be well marked.

In cases of recovery the mouth may remain sore for some time, the tongue swollen, the abdomen tender, the stomach very irritable, and there may be troublesome diarrhœa. In two instances there has been loss of voice for several days, owing to the action of the poison on the nervous system. Twitching of the muscles of the face and extremities has also been observed.

Post-mortem Appearances.—The mucous membrane of the fauces, œsophagus, and stomach is generally white and brittle, but often coloured with the brown mucous matter discharged. The stomach often contains a black fluid, like coffee-grounds, consisting principally of altered blood; and its submucous coats are vascular and dark coloured. The stomach, though seldom perforated, may yet be so softened as to be with difficulty removed entire, and sometimes this is not possible. This softening may be due to the post-mortem action of the poison; but its effects during life in softening and bleaching the mucous membrane are sufficiently marked. Occasionally the stomach is black and gangrenous looking. If death has occurred quickly, the small intestines are seldom much affected; but where the symptoms have been protracted, there are usually signs of congestion and inflammation.

Treatment.—Chalk, whiting, or magnesia, suspended in water, or in some demulcent fluid, must be administered immediately; and, if necessary, vomiting should be excited by tickling the fauces, or administering emetics of sulphate

of zinc and ipecacuan, followed by large quantities of emol lient drinks. The antidote, to be effective, must be give as soon as possible, the plaster of the apartment, or an form of mortar being used in the absence of the remedie just mentioned. Alkalies (soda, potash, or their carbonates are not only useless, but they form salts with oxalic acid which are as injurious as the acid itself. Where ther are symptoms of collapse, stimulants are to be freel employed.

From the tendency to softening, the stomach-pump shoul not be used.

Tests.—Crystals of oxalic acid are met with as four sided prisms, colourless, without odour, permanent in th air, and very acid; this last character distinguishing them from crystals of sulphate of magnesia and sulphate of zinc The crystals, when heated, melt, and are dissipated withou combustion, and leaving no residue. This character i important as a means of distinguishing oxalic acid from other similar crystals. They are soluble in from eight t twelve parts of cold water. This acid may be thus recog nised in solution:

1. *Nitrate of silver* throws down, with oxalic acid, an abundant white precipitate (oxalate of silver), which is soluble in nitric acid. The oxalate of silver, when dried and heated on platinum foil, detonates, and is dissipated in a white vapour.

2. *Sulphate of calcium* causes a white precipitate with oxalic acid (oxalate of calcium) which is soluble in nitric or hydrochloric, but not in any vegetable acid.

The solution containing the acid should be concentrated before testing, if it be not present in considerable quantity.

Lime water and all soluble lime salts throw down *precipitates* with oxalic acid; but as these are liable to be

mistaken for a precipitate with sulphuric acid, it is better to use sulphate of calcium, which is slightly soluble, as the test agent. A good deal of the test solution must be used, and the precipitate takes time to settle.

3. *Sulphate of copper* gives a faint bluish precipitate with oxalic acid (oxalate of copper), which is not redissolved by a few drops of hydrochloric acid.

These tests will not act if the solution contain nitric acid in excess, in which case the liquid must be evaporated to crystallization, and the crystals washed and redissolved in water.

These tests for oxalic acid should never be applied without previously separating it from all organic matter. This is best done by first of all acidulating the suspected fluid with acetic acid, and then adding acetate of lead, which combines with the oxalic acid to form a white insoluble salt, which may ordinarily be removed by filtration or subsidence. This filtrate, after being well washed, is to be diffused in water, and into this a current of sulphuretted hydrogen gas is to be passed for some considerable time. This will throw down the lead as sulphide, leaving the oxalic acid in the fluid; any organic matter will also be carried down. Filtration will separate the solids from the liquid containing the acid, which may now be evaporated until crystals are formed, which may be tested in the usual way.

ACETIC ACID.—Although this acid, in its concentrated state, is highly corrosive, yet it is very seldom brought under the notice of the toxicologist.

In the case of a young woman reported by Orfila, death quickly occurred after several attacks of convulsions. At the subsequent post-mortem examination, the integuments of the dependent parts of the body were found very livid; the tongue and œsophagus were of a dirty brown colour, the latter being intersected by a fine net-work of capillary

vessels; and the interior of the stomach was interspersed with black elevations caused by the presence of coagulated blood in the sub-mucous areolar tissue. The mucous membrane was entire.

As regards the *treatment*, it is only necessary to administer draughts containing magnesia or its carbonate, followed by mucilaginous or demulcent drinks.

TARTARIC ACID, though not a corrosive, may be here placed along with the other vegetable acids. Strange as it may seem, tartaric acid has destroyed life in at least one instance in this country; an ounce having been given in mistake for an aperient salt. The deceased swallowed the whole at once, and immediately called out he had been poisoned. He complained of intense pain in the throat and stomach, as if he had swallowed oil of vitriol, or was on fire. Soda and magnesia were administered without avail; and after death, at the end of nine days' suffering, the stomach and intestines were found much inflamed.

CHAPTER VIII.

THE CAUSTIC ALKALIES AND THEIR CARBONATES: POTASH, SODA, AMMONIA.

THE second division of the class of Corrosives has now to be considered. It contains the Caustic Alkalies, and some of their Salts. Poisoning by any of these agents is rare.

POTASH.—This substance, in its caustic state, as found in commerce, is in the form of grey-coloured cakes. It has an acrid taste, is soapy to the touch, and very deli*quescent*. *Moulded* in cylinders, it is often employed as

a caustic (Potassa fusa). In solution (Liquor potassæ) it is strongly alkaline, and imparts a brown stain to black cloth.

Potassium carbonate or *Carbonate of Potash* (Pearl-ash) is extensively used by laundresses and in the dressing of woollen cloth. It is generally sold in a granular condition, white, inodorous, and strongly alkaline; it is soluble in water, but not in alcohol.

CAUSTIC SODA.—This agent resembles potash in its general properties. The *Sodium Carbonate* or *Carbonate of Soda* (Soap-lees) bears a similar resemblance to the carbonate of potash, except that it crystallises easily, and effloresces on exposure to the air.

AMMONIA.—When pure, ammonia is a colourless, pungent gas; but it is commonly met with dissolved in water, as the liquor ammoniæ. Its vapour is poisonous, and may prove fatal by producing inflammation of the larynx and trachea, and even of the lungs. A case is recorded of a French boy, æt. six, who killed his younger sister by making her swallow several teaspoonfuls of a solution of ammonia. Other instances have also occurred where the liquor ammoniæ has either been taken in mistake for the aromatic spirit of ammonia, or purposely, to destroy life. An instance is recorded by Dr. Taylor, as occurring in the practice of Mr. Hilton, where liquor ammoniæ, given by mistake, caused corrosion of the throat and gullet, and obstruction of the bronchial tubes by false membrane. The œsophagus was completely dissolved at its junction with the stomach, and there was an aperture in the anterior wall of that organ such as might have been caused by oil of vitriol.

The *Ammonium Carbonate* or *Carbonate of Ammonia* (Hartshorn, Smelling Salts) has been used as a poison. It

may be distinguished from other salts by its being alkaline, by its entire volatility, and by its pungent odour. A young woman, in a state of unconsciousness, was made to swallow a quantity of hartshorn. In an hour there was great pain, sickness, and vomiting of blood. The hæmatemesis continued for some days, and then feebleness and emaciation set in, death occurring in three months. On examination the pylorus was found contracted to the size of a crow-quill, while there was a large cicatrix on the posterior wall of the stomach.

Symptoms.—The chief symptoms occasioned by the foregoing poisons are, an acrid, burning taste, with a sensation of excoriation and burning extending along the mouth and throat, to the stomach. There soon ensue exquisite pain in the epigastrium, and tenderness on pressure. Frequently there is cough, hoarseness, dyspnœa, as well as vomiting of altered mucus mixed with blood and detached portions of the mucous membrane. The tongue, mouth, and fauces become swollen, soft, and flabby, and deglutition is difficult. The surface of the body gets cold and moist, the pulse small and feeble, and there is great pain over the abdomen, with diarrhœa. Death took place, in the case of a boy, in three hours from the time of swallowing a strong solution of carbonate of potash. Ammonia, by its effect on the air passages, has proved fatal in four minutes. When recovery from the immediate effects of the poison has taken place, death has subsequently ensued from stricture of the œsophagus, producing starvation. By the proper use of bougies, &c., life may occasionally be prolonged for many months, or even for years. In some instances, however, it is almost impossible to effect dilatation, owing to the whole of the gullet becoming thickened and contracted, so that the opening into the stomach wi

hardly admit a crow-quill. The pylorus may also be contracted in like manner.

Post-mortem Appearances.—The mucous membrane of the mouth and gullet is softened and inflamed, and portions of it detached. The coats of the stomach and intestines are inflamed, stained of a dark colour, and sometimes ulcerated. When death has resulted from ammonia, signs of inflammation are usually found in the larynx and bronchial tubes. The other caustic alkalies may also destroy life by producing inflammation of the glottis, which consequently may be found thus occluded after death.

Treatment.—The object must be to neutralise the poison, which may be effected by a weak acid. Vinegar and water is perhaps the best antidote, and that most readily procurable: its administration may be followed up by freely allowing acidulated demulcent drinks, orange-juice, &c. The use of oil has been recommended, on the principle that it converts the alkali into a soap. But that its efficacy is doubtful has been in some measure shown by the death of two young children from swallowing a mixture of ammonia and oil. In one of these cases nearly two ounces of linimentum ammoniæ (made of one part of liquor ammoniæ to two of olive oil) were poured down an infant's throat by a child five years old. Were, however, the oil given in much greater abundance, the result would probably be different. At all events, its administration should not be neglected.

Tests.—The specific character of these substances is their strongly marked alkalinity, ammonia possessing, over and above, that of volatility. Potash is known from soda by *being precipitated* of a creamy yellow by platinum per-chloride, soda remaining unaffected by that reagent.

II.—SIMPLE IRRITANTS.

CHAPTER IX.

SALTS OF THE ALKALIES AND ALKALINE EARTHS.

POTASSIUM NITRATE or NITRATE OF POTASH (*Nitre, Saltpetre, Salprunelle*) is a more dangerous poison than is commonly supposed, provided the dose be large. It has ordinarily been given in mistake for other salts as a purgative, and in one instance caused death in about two hours, in another such instance, referred to by Orfila, an ounce proved fatal in three hours. It produces symptoms of irritation of the alimentary canal, vomiting, and diarrhœa. There is generally also severe pain at the pit of the stomach, trembling of the limbs, scanty urine, and collapse. Marks of violent inflammation are found after death in the stomach and along the intestinal canal.

POTASSIUM SULPHATE or SULPHATE OF POTASH (*Sal Polychrest, Sal de Duobus*, &c.) has proved fatal when taken in a large dose. It has caused death in two or three cases when purposely administered to procure abortion. Taylor quotes an instance of a lady, a week after delivery, being directed by her medical attendant to take ten drachms of this salt, in divided doses, as a laxative. After the first dose she was seized with severe pain in the stomach, with *vomiting, &c.; the* symptoms increasing after each dose,

and proving fatal in two hours. At the post-mortem examination the mucous membrane of the stomach and intestines was seen to be soft and pale, and the stomach contained a quantity of reddish-coloured liquid. This, on being analysed, was found to contain no other irritant but this salt.

BITARTRATE OF POTASS or HYDROGEN POTASSIUM TARTRATE (*Cream of Tartar*, *Argol*).—This salt has caused death in one case at least, in which about an ounce and a half was taken. The symptoms were those of an irritant poison, with paralysis of the lower extremities. Death occurred within forty-eight hours.

SULPHURET OF POTASSIUM (*Liver of Sulphur*) has also caused death as an irritant poison.

Treatment.—As no antidotes are known to these salts the treatment must consist in producing vomiting as speedily as possible by means of emetics; or the stomach-pump may be used. Demulcent drinks should be freely given subsequently, with soothing applications to the bowels. Ice may be given in any quantity.

LIME acts as an irritant poison, though a feeble one, when taken into the stomach or applied to a vital part. One fatal instance is reported, where a boy swallowed some lime in an apple-pie. He died in nine days, after suffering from a burning pain in the abdomen, great thirst, and obstinate constipation. Unslaked or imperfectly slaked lime may also prove fatal by being inhaled, and so giving rise to inflammation of the glottis.

BARIUM SALTS.—Two preparations of barium have caused death, viz., the chloride and the carbonate. These may also give rise to specific nervous symptoms, as cramps and convulsions.

Chloride of Barium is found crystallised in irregular

plates or tables, which are permanent in the air, soluble in water, and of a disagreeable bitter taste. Half an ounce has proved fatal in two hours, after causing symptoms of irritation, with vertigo, paralysis and convulsions.

Carbonate of Baryta or *Barium Carbonate*, in its native state, occurs in massive radiated crystals, very heavy, and nearly colourless. Artificially prepared, as sold in the shops, it is a fine, tasteless, odourless powder, almost insoluble in hot or cold water. One drachm is said to have destroyed life, but recovery has taken place after a much larger dose.

Treatment.—The sulphate of soda or sulphate of magnesia, or some earthy sulphate, should be speedily administered, by which the poison will be converted into an inert insoluble sulphate of baryta. Emetics should also be given, or the stomach-pump used.

CHAPTER X.

SALTS OF THE METALS: ZINC—SILVER—TIN—BISMUTH—CHROME—IRON.

TWO preparations of ZINC must be noticed:

SULPHATE OF ZINC (*White Vitriol, White Copperas*).—This is a very mild irritant, resembling in its appearance Epsom salts and oxalic acid. It is very useful as an emetic in scruple or half-drachm doses, dissolved in any thin fluid.

In one case an ounce was accidentally taken. Great pain in the stomach, vomiting, and prostration, soon set in. Subsequently there was gastritis, and recovery only occurred after a prolonged convalescence.

Treatment.—Vomiting is to be encouraged by milk or *albuminous fluids*; after which remedies containing

tannin (strong tea, decoction of oak bark, or tincture of Peruvian bark) are to be given.

CHLORIDE OF ZINC.—A solution of chloride of zinc forms a valuable disinfectant, but is also a dangerous irritant, or, if sufficiently strong, a corrosive poison. Sir William Burnett's Fluid consists of gr. xxv of this salt to the drachm of water. It has been taken in mistake for fluid magnesia, pale ale, &c., and has caused death.

Symptoms.—A burning sensation in the mouth and throat is immediately produced. This is followed by nausea, vomiting, and signs of collapse. Death has occurred in less than four hours.

Post-mortem Appearances.—The mucous membrane of the throat and stomach has been found corrugated, hard, and leathery. In the case of a sailor who died from about half a pint of Burnett's solution, the body was livid, the neck swollen, the cerebral vessels were engorged, and the lungs were congested. The mucous coat of the stomach was of a purple red, and partially corroded, while the pyloric orifice looked as if caustic had been applied to it. There were patches of congestion in different parts of the small intestines.

Treatment.—Albuminous drinks, followed by some preparation of tannin, will be needed.

Tests.—Zinc is distinguished from all other substances by giving a white precipitate with sulphuretted-hydrogen. The solution containing it must not be too acid or no precipitate will be formed. Zinc also gives white precipitates with ferrocyanide of potassium and ammonia.

NITRATE OF SILVER (*Lunar Caustic*).—This is a powerful irritant, and has proved fatal in at least two instances. The antidote is common salt, which must be given immediately, followed by emetics.

TIN.—The chlorides of tin being employed in dyeing, colour-making, &c., may lead to their being used as poisons, or being taken accidentally. Death from their use is rare. They are decomposed by magnesia, which should therefore be freely administered, followed by albuminous and mucilaginous drinks.

BISMUTH.—The nitrate or magistery of bismuth has caused death in nine days, after a dose of two drachms. The symptoms were those of a strong irritant, but in all probability were caused by some impurity in the substance. Arsenic is frequently present in this way. As no antidote is known, vomiting must be promoted and emollient drinks freely given.

CHROME.—The bichromate of potassium is found in the form of orange-red crystals, which yield a yellow acid solution. It is used as a dye, and has caused death in more than one instance. Emetics, and magnesia or chalk, must be the remedies employed.

It is well to know that this substance is apt to produce troublesome sores on the hands of those engaged in its manufacture. Some slight abrasion begins the lesion, which does not heal, but forms on its surface a tough slough, which separating, leaves a foul ulcer with hard edges, and most untractable, behind it.

SULPHATE OF IRON (*Green Vitriol, Copperas*).—Although not a powerful irritant, sulphate of iron has proved fatal when taken in a large dose. It is sometimes given to procure abortion. The *perchloride of iron* has also produced alarming symptoms, after being taken for the same purpose. Dr. Christison relates the case of a man *who died in five weeks* from an ounce and a half of the *tincture. Magnesia* and diluents, freely administered, must *constitute the treatment.*

CHAPTER XI.

SIMPLE VEGETABLE AND ANIMAL IRRITANTS.

THIS division of the class of simple irritants is an important one, on account of the substances composing it consisting in considerable part of ordinary remedies or drugs, which, given in over doses, may produce symptoms of poisoning. They chiefly give rise to vomiting and purging.

VEGETABLE IRRITANTS.

The most important are *aloes, colocynth, jalap, gamboge, scammony, elaterium, croton oil, castor-oil seeds*, various species of *arum, euphorbium, bryony, mesereon, physic nut*, and others less commonly known. Dr. Taylor says that aloes and colocynth are the basis of *Morrison's pills*, which in many instances have induced fatal purging. In *Holloway's pills*, aloes is the chief ingredient. A favourite remedy with nurses for promoting the catamenia is *hiera-picra*, a brown powder consisting of four parts of aloes to one of canella bark. This may give rise to dangerous symptoms.

The *symptoms* induced by these substances are those of irritation of the intestinal canal, severe pain, vomiting, diarrhœa, tenesmus, &c.; followed by collapse, cold sweats, and occasionally convulsions. These effects may also be produced by diseased and decayed vegetables.

The *treatment* must be directed to the removal of the injurious substance by emetics, &c., unless spontaneous *vomiting* has freely taken place, when it need merely be *encouraged* by the use of diluents. If the irritant has *passed out* of the stomach into the intestines it must

carried off by purgatives, especially castor oil. The inflammatory symptoms should be cautiously combated, on account of the great prostration usually caused by these poisons. Opiates, emollient enemata, and fomentations to the abdomen will subsequently be found useful.

SIMPLE ANIMAL IRRITANTS.

The substances which require consideration under this head, though few, are important.

Poisonous Fish.—Several kinds of fish are constantly poisonous, while some only act injuriously on particular constitutions. The chief effects are sickness and vomiting, irritation of the eyes, depression, and severe urticaria or nettle-rash. In this country the different varieties of shell-fish are those most frequently injurious, especially cockles, mussels, crabs, and such-like.

Poisonous Meat.—The flesh of animals which have died of disease has produced serious symptoms when eaten, and has even destroyed life. Several substances, as sausages, cheese, bacon, &c., also become poisonous from putrefaction.

The *treatment* in these instances should consist in the use of emetics, purgatives, and diluents. The vital powers must be supported by stimulants, tonics, nutritious diet, &c.

CHAPTER XII.

IRRITANT GASES.

The chief are chlorine, sulphurous-acid gas, nitrous-acid *gas, and hydrochloric-acid* gas. When diluted, they admit *of being inhaled; not so* when pure.

Chlorine.—This gas has a greenish-yellow colour, and a powerful suffocating odour. It is used to fumigate buildings, being a valuable disinfectant. Chlorine is employed by the calico-printer and paper-maker for its bleaching properties. The men who work in an atmosphere slightly impregnated with it suffer from dyspepsia, but are long-lived, and it has been supposed to be actually beneficial to consumptives. Any attempt to inspire chlorine in its concentrated state would at once prove fatal by closing the glottis and causing asphyxia. When diluted, it excites excessive irritation of the air-passages, cough, difficulty of breathing, and inflammation.

In poisoning by chlorine, the inhalation of a small quantity of sulphuretted hydrogen appeared to afford relief in a case reported by Christison, but with that, or any other of the irritant gases, our treatment must chiefly consist in the instant removal of the sufferer to pure air. Then the cautious inhalation of ammonia, sulphuric ether, or the vapour of warm water, will be useful.

Sulphurous Acid Gas is one of the products formed by the combustion of ordinary coal. It possesses bleaching and antiseptic properties; and is very irritating when inspired.

Nitrous Acid Gas is a very violent poison when inhaled, producing inflammation of the lungs, &c. It has proved fatal in several instances, when given off by nitric acid.

Hydrochloric Acid Gas is irrespirable in its concentrated state, and when diluted produces great irritation of the lungs and air-passages. This gas, which is a waste product in the manufacture of washing soda, is the chief cause of the barrenness which surrounds soda works where it is allowed to escape, it being extremely destructive to vegetable life.

Ammonia.—It has been already noticed (p. 35) that the vapour of ammonia is poisonous, exciting inflammation of the larynx, bronchitis, and pneumonia. Serious symptoms have sometimes arisen from its indiscriminate application in cases of syncope, &c.

III.—SPECIFIC IRRITANT POISONS.

By Specific Irritant Poisons we mean those which, taken internally, produce local inflammation or irritation, these being of course indicated by certain constitutional symptoms; but over and above these, which may be the result of ordinary inflammation, there are certain specific signs of the action of a poison, in most instances peculiar, and frequently pointing directly to the poison employed. This group is one of the utmost importance in Toxicology, and includes substances acting in many different ways, all, however, giving rise to the common symptom of gastric irritation.

CHAPTER XIII.

SPECIFIC MINERAL IRRITANTS.

IODINE AND IODIDE OF POTASSIUM.

Iodine is obtained from kelp (the ash of marine plants and is a bluish black scaly substance. It strikes an intense blue colour with starch, and when heated gives off an irritating purple vapour. It likewise imparts a yellowish-brown stain to the skin (which may be removed by liquor potassæ) and mucous membranes, and slowly corrodes these tissues.

Iodine is an active poison, although its effects are variable. Some constitutions are violently affected by two c

three grains, whereas others are uninjured by ten or twenty. Iodine is commonly employed in medicine in combination with potassium (iodide of potassium). Of this substance very large doses may be given (thirty grains or more, three times a day) in tertiary syphilis, with none but good effect.

The *symptoms* of poisoning by iodine consist of an acrid taste, tightness about the throat, epigastric pain, vomiting, and purging, especially if much has been taken. In a case which came under observation, a man took an ounce of the compound tincture of iodine, in mistake for a purgative draught. He was immediately seized with an intense burning pain in the throat and epigastrium, and vomiting, followed by great thirst, headache, and syncope. The vomiting was encouraged, large quantities of arrowroot given, starch enemata administered, and in twelve hours all the symptoms had disappeared, leaving him in a state of exhaustion, from which he recovered in a few days.

In chronic poisoning (iodism) there are signs of irritation of the alimentary canal, often a measly eruption, ptyalism, running from the nose and eyes, mental and bodily depression, and loss of flesh. Nothing leads to the belief that it causes absorption of the testicles or mammæ, as is often asserted.

The *post-mortem appearances* would be those due to an irritant poison, namely, inflammation and softening of the stomach; the mucous membrane being detached in different parts, and stained of a yellow colour.

The *treatment* should consist in the encouragement of vomiting, and the free administration of amylaceous fluids, as gruel, arrowroot, boiled starch, &c. This should be *continued until the* matters vomited are of their natural *colour; for as long as* any iodine remains they will be *rendered blue, iodide of* starch being formed.

The crystals *of iodide of potassium* are white cubes, very soluble in water, and permanent in the air; though when impure they have a yellowish tinge, and are deliquescent. In a few instances this valuable medicine appears to have given rise to troublesome symptoms, even when administered in small doses. Mr. Erichsen has reported a remarkable case, in which five grains produced coryza, conjunctivitis, difficulty of breathing, and other serious effects, promptly ceasing with the discontinuance of the medicine. The *treatment* must consist in emptying the stomach by emetics or the stomach-pump, and administering starchy diluents.

Tests. 1. Iodine may be readily detected by the blue colour it gives to starch.

Iodide of potassium gives the same when the iodine is set free by an acid, such as sulphuric acid.

2. It also forms a scarlet precipitate with perchloride of mercury; and

3. It gives a yellow precipitate with acetate of lead.

CHAPTER XIV.

PHOSPHORUS.

THIS substance is sold in a pure state in small wax-like cylinders, which must be preserved under water. It is soluble in oil, alcohol, ether, and chloroform, and still more so in carbon disulphide; it is luminous in the dark, and it ignites at a very low temperature, giving off a dense white *smoke.* *Phosphorus is much more frequently used as a poison abroad than in England; but since restrictions have been put on the sale of poisons, and rat poisons containing*

it have been more common, cases of poisoning have more frequently occurred, and are likely to do so even oftener in future. The cases which have occurred show that it is a very powerful irritant, and capable of causing death when taken, even in small doses. One grain has caused death; the shortest period in which it has followed the administration of the poison being four hours.

The phosphorus paste sold consists of flour, sugar, and fat, with phosphorus, ordinarily coloured with Prussian blue. Colouring matter is also generally present in lucifer-match tops, which contain phosphorus and chlorate of potash, or nitre; hence, the vomited matters after either of these has been swallowed may be variously coloured. In the so-called 'safety matches' the phosphorus is on the box and not on the match. Phosphorus does not readily lend itself to the purposes of the criminal, its luminosity, its taste, and its garlic odour rendering it difficult of concealment.

The *symptoms* of poisoning by phosphorus are very varied, often insidious. At first there may be merely the ordinary signs of irritant poisoning. The vomited matters are luminous in the dark, sometimes bilious, sometimes bloody. There is very great prostration, and there may be diarrhœa with bloody stools. These symptoms sometimes abate, and everything seems going on well, when suddenly a new train of symptoms, still more serious, develope themselves. These are such as would occur in the worst forms of blood poisoning: harsh, dry, yellow skin, with discharges of blood from the various passages, and the formation of extravasations below the skin. The *urine is ordinarily* retained or suppressed, what little there *is being albuminous* or bile-stained. Finally, acute delirium *with convulsions sets in*; the patient dies comatose a few

hours after taking the poison, or it may be as many months.

The *post-mortem appearances* after death by phosphorus are very peculiar. If the case has proved rapidly fatal there will be the ordinary signs of irritant poisoning, with, in addition, softening of the stomach, bloody or gangrenous patches, blood in the intestines and bladder, and bloody serum in the peritoneal cavity. In many respects the lesions resemble those of the worst forms of sea scurvy; but the most marked changes are the remarkable fatty degeneration of the liver, kidneys, heart, and other muscles, especially of the first, which is often greatly atrophied.

The diagnosis will depend on the peculiar odour of garlic exhaled by the patient and the luminosity of the vomited matters, in addition to the other signs referred to.

Treatment.—There is no regular antidote for phosphorus; early evacuation by the stomach-pump and the free promotion of vomiting are the main points. Magnesia or its carbonate should be given freely in mucilaginous fluids. Oils had better be avoided, except for the purpose of removing all traces of the poison by the stomach-pump. Prompt treatment is all in all.

Detection.—There is but one really satisfactory plan for detecting phosphorus in organic mixtures, that invented by Mitscherlich. The suspected material is introduced into a retort, and acidulated with sulphuric acid. The stem of the retort is conducted into a glass vessel kept cool by a stream of water on the outside. The retort is heated, and destillation allowed to go on in the dark. If *phosphorus be* present it passes over as vapour, and is *condensed in the* cool vessel beyond. At each condensation *a flash of light* is perceived, which is the test relied on.

CHRONIC POISONING by phosphorus used to be exceedingly common among match manufacturers, but is now, comparatively speaking, rare, allotropic or amorphous phosphorus being much more generally employed than it used to be, and the ventilation of the workshops being better. Its subjects used to be attacked with caries of the gums, gradually extending and implicating the jaw, and giving rise to great deformity.

CHAPTER XV.

ARSENIC.

ARSENIC is by far the most important of metallic poisons, whether we consider the deadliness of its effects or the fatal frequency with which they are made manifest. Arsenic exists as an impurity in several metallic ores, notably in iron pyrites, which being commonly employed as a material for the manufacture of sulphuric acid, renders arsenic one of the most frequent impurities of commercial oil of vitriol. This should never be forgotten in testing any substance for the poison. To the common medicinal preparation of arsenic, consisting of *arsenious acid*, or *arsenites*, and the so-called *chloride of arsenic*, must be added the *arseniates of potash and soda;* the sulphides of arsenic—as, the *red sulphide*, or *realgar*, and the *yellow sulphide*, or *orpiment;* the *arsenite of copper*, or *Scheele's green*, and others. They all produce similar symptoms, and poisoning by either of them requires nearly the same treatment.

According to Von Tschudi, some of the peasants in parts of Styria and Hungary eat arsenic, taking from two to five grains daily; the men doing so in order that they may gain strength, and be able to endure fatigue, the wom

that they may improve their complexions. These statements are so contrary to all that we know of the power of this poison, that they have been regarded as unworthy of credit. Evidence has, however, been brought forward by Dr. Craig Maclagan, of Edinburgh, which shows clearly that arsenic-eating is something more than a mere fiction. This gentleman gave, and saw a Styrian eat, a piece of arsenious acid, weighing over four grains, and afterwards determined the presence of arsenic in urine passed in his presence by the said peasant. Advantage was taken of these reports in the trial of Miss Madeline Smith (Edinburgh, July, 1857), when the court was asked to believe that arsenic found in the possession of the prisoner was used by her as a cosmetic.

Arsenite of Copper, in one form or another, either as Scheele's green, emerald green, Brunswick green, &c., is unfortunately largely employed in the manufacture of green paper-hangings, artificial flowers, toys, and even some kinds of confectionery. Too many cases of ill-health caused by this practice have been recorded to permit any doubt as to its deleterious effects. These may be manifested by people living in rooms furnished with such paper-hangings. The chief symptoms are, sneezing, lachrymation, frontal headache, nausea, and loss of appetite, with colicky pains, thirst, &c. Among those employed in preparing the paper-hangings more serious symptoms manifest themselves. The irritation of the pigment gives rise to circular patches of ulceration on the alæ of the nose, in the folds of the arm, in the groin and scrotum—in short, wherever dirt tends to lodge. These prove very untractable, except the employment be abandoned. In November, 1861, a young woman died in London from the poisonous effects of arsenite of copper used in dusting wax leaves. The workmen w

employ the pigment in its dry state suffer, while those who use it in a moist condition are probably unaffected by it. A simple method for roughly detecting arsenite of copper in these fabrics was published in the *Chemical News* (vol. 1, p. 12). A small portion of the suspected material is to be put into a test tube with strong ammonia. If a blue tint be produced, a salt of copper is shown to be present. Withdraw the object, and drop a piece of nitrate of silver into the ammonia; if arsenic be there, the nitrate of silver will be covered with a yellow coating of arseniate of silver, which will disappear on stirring. On igniting arsenical paper and allowing it to smoulder, the odour of garlic may be detected in the fumes given off. Another mode in which the noxious effects of arsenic are produced is by the use of bright green tarlatans as ball dresses. One could hardly conceive a more deadly amusement than dancing in an arsenicated dress, sweeping against an arsenicated wall-paper. When both are lightly adherent the arsenic is scattered in showers about the room.

ARSENIOUS ACID (*White Oxide of Arsenic, White Arsenic, Arsenic*).—This is the preparation of arsenic most frequently used as a poison; the facility with which it used to be procured, its cheapness (twopence an ounce), and the ease with which it may be administered, all tended to recommend it to the murderer or suicide. According to a parliamentary report, the number of fatal cases of poisoning in England in the years 1837, 1838, amounted to 543, of which no less than 186 were caused by arsenic, 185 arising from the use of the arsenious acid, and 1 from orpiment or yellow arsenic.

Since the Act of 1851 (14 Vict. cap. xiii.) the deaths *from this agent have* greatly decreased. This statute *chiefly enacts that* arsenic is not to be sold without the

eller entering the transaction in a proper book, without a witness, nor without its being mixed with soot or indigo, unless such admixture would render it unfit for the purchaser's business.

Arsenious acid is found in commerce in the form of a white powder or in small opaque cakes. It is very feebly acid, tasteless, or slightly sweet in small doses, though not very soluble, an ounce of cold water dissolving about one grain. The quantity so held in solution may, however, be increased by dissolving the arsenic in boiling water and allowing it to cool. The shortest period within which it was believed arsenic would cause death was two hours; but Dr. Taylor gives a case where death with tetanic symptoms followed the fatal dose in twenty minutes. The smallest quantity known to have proved fatal is two grains. Two grains and a half killed a girl nineteen years of age in thirty-six hours. Half a grain will produce alarming symptoms; and yet recovery has ensued after doses of half an ounce or an ounce.

Symptoms.—These commence within half an hour or an hour of swallowing the poison. There is faintness, nausea, incessant vomiting, and a burning pain in the epigastrium, increased on pressure, and gradually extending over the whole abdomen, followed by headache, diarrhœa, a sense of constriction and heat in the fauces and throat, great thirst, and catching, painful respiration. The heart's action becomes depressed, the pulse is quick and feeble; there is great restlessness and anxiety; cold, clammy skin, and perhaps coma are present; and death usually occurs within twenty-four hours.

These symptoms are liable to great variety, the pain and vomiting being occasionally absent, and the patient being affected as if by a narcotic poison. In some instances

there is troublesome tenesmus, with heat and excoriation about the anus. Convulsive movements in the extremities often occur, with cramp in the legs, especially if the diarrhœa is severe. Death sometimes takes place calmly from collapse, sometimes it follows on convulsions.

The vomited matters may be red or brown from admixture with blood or bile; or they may be blue or black, if the arsenic has been coloured with indigo or soot. Although the vomiting, pain, &c., are generally continuous, yet sometimes all the symptoms remit, and the patient rallies for a time, only to sink more rapidly.

The symptoms of *chronic* poisoning by arsenic are loss of appetite, a silvery coating to the tongue, thirst, nausea, colicky pains, diarrhœa, frontal headache, languor, sleeplessness, cutaneous eruptions, soreness of the edges of the eyelids, emaciation, anæmia, convulsions, and death. In some cases, when small doses have been administered for many days in succession, with the intent to destroy life, the symptoms have been masked by other substances. The most marked results of this practice have been sickness and vomiting, pain in the bowels, nervous irritability, and emaciation. The practitioner must be careful not to mistake these symptoms for those due to simple gastritis or enteritis.

Arsenic is not a poison that accumulates in the system but is slowly eliminated from it, especially by the kidneys but partly also by the bile.

The local application of arsenic to the mucous membranes, to wounds, or to surfaces deprived of their cutic *produces constitutional* effects similar to those just *scribed. The only difference* is that the symptoms sh *themselves more slowly.* Not a few lives have been s *ficed from the application* by ignorant quacks of a m

of arsenious acid, realgar, and oxide of iron to ulcerating cancers.

Cases of compound poisoning have been met with. When arsenic is taken mixed with opium, the symptoms produced by the former are masked.

Post-mortem Appearances.—Arsenic appears to exercise a specific influence over the alimentary canal, and more especially over the stomach; for in whatever manner it may have been introduced into the system, it is to this organ that we must look for its effects. These effects consist in the signs of acute inflammation commencing in this viscus, and often extending along the duodenum, small intestines, and colon. In acute cases the stomach is the viscus most affected; but in chronic cases the whole alimentary canal is found inflamed and ulcerated, particularly the duodenum and rectum. When death has occurred within five hours of taking the poison, the stomach has been found intensely inflamed in an adult; while the same result was witnessed in a child who died at the end of two hours. The stomach often contains a dark grumous fluid, occasionally tinged with blood. On removing the contents the mucous membrane is seen red and inflamed, the inflammation being most intense around certain spots. On examining these spots, particles of arsenic will probably be found adhering to the walls of the stomach and surrounded by a zone of inflammatory redness. Sometimes also blood is effused into the visceral walls, giving rise to an appearance resembling gangrene. Ulceration of any of the coats of the stomach is rare, and perforation is still more so.

In a few exceptional cases there has been no appearance of inflammation in the stomach or bowels.

Putrefaction of the body is said to be remarkably retarded after death from arsenic.

Treatment.—The first object must be to expel the poison from the stomach, for which purpose the stomach-pump may be advantageously employed, or emetics of sulphate of zinc, mustard, or ipecacuan administered, unless vomiting is already present. The sickness must be promoted by the free use of albuminous or mucilaginous diluents. Raw eggs beaten up in milk are particularly useful, as is likewise a mixture of albumen, milk, and lime-water. Taylor advises equal parts of oil and lime-water, for the oil invests the poison, and the lime renders it less soluble. A large dose of castor oil (ʒj to ʒij) may be given, to carry off any of the poison which may have passed into the intestines, as soon as sickness has subsided. Animal charcoal, calcined magnesia, &c., when taken in large quantities, may be of service by enveloping the arsenic, and preventing its contact with the mucous membrane of the stomach; but oil or milk will act more efficiently in this manner. The hydrated peroxide of iron* should be administered moist, and in large doses, after the stomach-pump has been used; or indeed, mixed with water, it may be first introduced and then expelled, thus washing out the stomach by means of the stomach-pump. This is the most efficient antidote known.

The subsequent treatment must be conducted on general principles, according to the severity of the symptoms; but the great depression of the nervous and vascular systems

* If not kept prepared, the remedy may be speedily got ready in any chemist's shop in the following way: Mix together the contents of the bottles containing tincture of the muriate of iron (the liquor ferri perchloridi does as well) and liquor ammoniæ fortior. Run the mixture through a loose filter, saving *the precipitate*; turn filtering paper or tow, if that has been used, *and all into* a vessel containing water, agitate well, and use the *precipitate by spoonfuls* as it falls to the bottom.

must not be overlooked in combating any inflammatory action. Henbane or opium, in many instances combined with stimulants, ice internally, and hot fomentations externally, will frequently be found of great service.

Tests.—In its *solid state* arsenious acid may be known by the following properties. Heated on platinum foil or on the point of a penknife, it produces a white smoke and is entirely volatilised. If some of the powder be heated in a small test tube, it will be sublimed, and small octahedral crystals, visible to the naked eye or by a lens, obtained. If arsenious acid be mixed with freshly-burnt powdered charcoal, and heated in a small test-tube, a ring of shining metallic arsenic of a grey colour will be found on the cool portion of the tube, and an odour of garlic is perceptible. If this deposit be driven about from place to place it will gradually become oxidised, and octahedral crystals of arsenious acid formed. Further, if the tube be divided and the part containing the arsenious acid be washed out with distilled water, the liquid tests may be applied to the solution. This is called the Reduction test. It is very delicate, detecting, according to Christison, the 300th part of a grain.

In solution, this substance may be detected by what are called the liquid tests. A solution of arsenic in water is colourless, almost tasteless, and has a very slightly acid reaction. If a few drops be evaporated on a glass slide and examined by the microscope, numerous minute and mostly imperfect octahedral crystals, or an amorphous deposit, will be seen, presenting triangular surfaces by reflected light.

1. *The ammonio-nitrate of silver* (prepared by adding a few drops of liquor ammoniæ to a solution of nitrate of silver, till the brown oxide of silver at first precipitated

nearly redissolved) throws down with arsenious acid a rich yellow deposit of arsenite of silver.

2. The *ammonio-sulphate of copper* (formed by adding liquor ammoniæ to a solution of sulphate of copper till the bluish-white oxide of copper is almost redissolved) produces a pale green precipitate, arsenite of copper, or Scheele's green. Care must be taken not to add too much of the test in the first instance, otherwise its blue may overpower the green of the precipitate.

3. *Sulphuretted hydrogen water* precipitates a yellow deposit of sulphide of arsenic. It is better, however, to use pure and well-washed sulphuretted hydrogen generated in the usual manner. Care must be taken that the liquid is not alkaline, or no precipitate will be produced, even though arsenic be present. For this reason yellow sulphide of ammonium will not precipitate arsenic until acidulated with pure hydrochloric or some such acid. The precipitate should be collected, carefully washed, and dried. It should then be mixed with black flux or dry ferrocyanide of potassium and reduced, as already described,

These tests are so delicate, especially the first, that they will detect the 8,000th part of a grain of arsenic in solution; they should be employed successively. There are several other processes which require to be noticed, namely, Marsh's process, the process known as Reinsch's process, Fresenius' process, and the Destillation process.

Marsh's Test or Process.—This process is founded on the decomposition of arsenious acid by nascent hydrogen, and the formation of arsenuretted hydrogen gas, which possesses the following properties: It burns with a bluish-white *flame, and white* smoke (arsenious acid), possessing a slight *garlic odour. If* a piece of glass or porcelain be held in *the flame a blackish* metallic stain will be deposited upo

it, consisting of metallic arsenic. This stain might be confounded with one produced by antimony under similar circumstances. But the antimonuretted hydrogen gas does not burn with the odour of the arsenuretted hydrogen; while the antimonial stain is sooty, and has not a metallic lustre. The arsenical stain is further readily dissolved by a solution of chloride of lime (bleaching powder), whilst the antimonial stain is not affected. To the stain may be added a few drops of strong nitric acid; it will dissolve the arsenic; if this be allowed to evaporate, and the acid be neutralised, a few drops of nitrate of silver solution will give a brick-red precipitate of arseniate of silver.

Marsh's test is thus accomplished: a flask furnished with a cork through which pass a funnel and a long bent tube drawn to a point, is prepared, so that the funnel reaches almost to its bottom. Several pieces of pure zinc are introduced, and then some sulphuric acid is poured through the funnel. In this way hydrogen gas is produced and escapes by the bent tube. When all the air has been expelled the gas should be ignited as it escapes, and a piece of cool porcelain held over the flame. If there be no deposit it is plain that neither the zinc nor the sulphuric acid contains arsenic. A portion of the suspected fluid is next introduced into the flask by the funnel, and the issuing gas again tested. Should a stain giving the characters alluded to above be produced, the fluid contains arsenic in some form or other.

Reinsch's Process.—The suspected liquid is boiled with from one-sixth to one-eighth of its bulk of pure hydrochloric acid, and a bright slip of copper introduced. If arsenic be present the copper will be coated with it, in the form of an iron-grey deposit. Next after removing the copper, washing it with distilled water, and drying it between folds

of blotting paper, cut it into slips, and introduce it into a reduction-tube and apply heat; arsenious acid will be sublimed and deposited on the sides of the tube, in the form of minute octahedral crystals. These may be dissolved in water and tested in the usual way. Before resorting to this test, the acid must be examined to make sure of its purity. This is easily effected by boiling the copper with a mixture of the hydrochloric acid and distilled water before adding the suspected liquid. In conducting the analysis in the case of Smethurst (Cent. Crim. Court, Aug. 1859) Taylor and Odling found that all the varieties of copper in common use for Reinsch's process contained arsenic. A copper of ascertained purity must therefore be used.

Arsenic in Organic Matters.—The following process, which has been introduced by Dr. Taylor, is a very convenient one. The suspected matters are to be thoroughly dried in a water-bath or otherwise, taking care not to use too great a heat. They are then to be introduced into a flask fitted with a long bent tube; to the dried material is to be added a quantity of strong hydrochloric acid, proved free from arsenic, sufficient to drench it, and the whole allowed to digest for some hours. At the end of that time heat is to be applied to the flask by means of a sand-bath, and a receiver fitted to the bent tube. The receiver should contain a little water, and both it and the bent tube should be kept cool. As destillation goes on the arsenic passes over in the form of chloride of arsenic, and is collected in the receiver beyond. A second portion of hydrochloric acid may be used to remove any last traces of arsenic in the *organic material.* The arsenic may be recovered from the *chloride by boiling* with pure polished copper, as in *Reinsch's process.*

The process of Fresenius and Von Babo given at page 19

is especially adapted for the recovery of arsenic from organic admixture.

Several cases of poisoning by arsenuretted hydrogen are on record, some proving fatal.

CHAPTER XVI.

ANTIMONIAL COMPOUNDS.

In its metallic state antimony is not regarded as poisonous. Two of its preparations, however, claim attention; namely, tartar emetic, and chloride of antimony.

Tartar Emetic (*Tartrated* or *Tartarised Antimony, Potassio-Tartrate of Antimony, Tartar Emetic*).—Since the trials of Palmer, Dove, Smethurst, and Pritchard, poisoning by this compound has attracted much attention. In large doses it has been administered without any serious result, a circumstance which may be accounted for by the promptitude with which it excites vomiting and purging. Given in small doses, frequently repeated, the effects of tartar emetic may be made to simulate, in some degree, those due to natural disease.

Three-quarters of a grain killed a child; and a dose of two grains has destroyed an adult, under circumstances which favoured its action. Dr. Taylor says that from ten to twenty grains taken at once might prove fatal to an adult; while in divided doses a smaller quantity might suffice. It is plain, therefore, that the quantity necessary to cause death must vary with the condition of the patient.

Symptoms.—In acute poisoning by this agent there is a metallic taste, nausea, and violent vomiting, burning

heat with pain in the stomach, and purging. Difficulty in swallowing, thirst, cramps, cold perspiration, and great debility soon set in. Should the case terminate fatally, death may be preceded by giddiness, insensibility, difficult respiration, utter prostration, with violent spasms, tonic or clonic; but even when matters appear to be most critical, symptoms of improvement are often manifested, and recovery gradually follows.

The effects of *chronic* poisoning are, constant nausea, frequent attacks of vomiting and purging, a loathing for food, a weak frequent pulse, loss of muscular power, cold clammy sweats, and fatal exhaustion. The symptoms are of course aggravated after each administration of the poison, whether given in food or medicine.

Tartar emetic ointment applied to the skin produces a pustular eruption like that of smallpox; while, if much be absorbed, there will be nausea, sickness, &c. Sometimes this same eruption appears in the throat and on the skin after swallowing a large dose.

Post-mortem Appearances.—The most common are inflammation of the throat, stomach, and intestines. Sometimes the mucous membrane of the stomach is softened and infiltrated with blood. The cæcum and large intestine are also inflamed, especially if life has been prolonged after the dose, as in chronic poisoning. The brain and lungs have been found congested.

Treatment.—Vomiting should be encouraged by warm greasy water, milk, &c. Liquids containing tannin, as tea without milk or sugar, decoction of oak bark, &c., must *be freely given.* Cinchona bark in tincture or powder may *be advantageously* prescribed. Afterwards opiates may be *administered.*

Tests.—Tartar emetic is soluble in water but not in alcohol.

In solution tartar emetic may be thus detected:

1. A drop evaporated on a glass slide leaves microscopic crystals, either tetrahedra or cubes, with the edges bevelled off.

2. The solution may further be proved to contain antimony by passing through it sulphuretted hydrogen or adding to it sulphide of ammonium, either of which throws down an orange-red precipitate of sulphide of antimony. This precipitate is soluble in strong hydrochloric acid, which, being diluted, throws down a white precipitate.

3. The three dilute mineral acids (nitric is best) throw down a white precipitate with tartar emetic, which is soluble in excess of the acid used or in tartaric acid.

The metal may be separated from organic substances by Marsh's or Reinsch's process.

CHLORIDE OF ANTIMONY (*Terchloride* or *Butter of Antimony*) is a powerfully corrosive liquid. It produces violent inflammation and corrosion of the whole intestinal canal; occasionally also drowsiness, as from the use of a narcotic.

Dr. Taylor has collected the histories of four cases of poisoning by butter of antimony, three of which recovered. The fourth, in which a gentleman took from two to three ounces, proved fatal in ten hours and a half, after producing great prostration, nausea, violent griping pain, and tenesmus, followed by a tendency to sleep. On inspection, the whole of the inside of the alimentary canal was blackened, as if it had been charred; there was but little mucous membrane remaining, and the parts were much softened.

Treatment.—Magnesia must be administered in milk, *together with* the remedies recommended in poisoning by *tartar emetic.*

CHAPTER XVII.

MERCURY AND ITS COMPOUNDS.

he preparations of mercury, corrosive sublimate i
ost important to the toxicologist; for although the
ssess in a greater or less degree poisonous proper
et the instances in which the other compounds hav
used to destroy life are extremely rare. The treat
in all cases must be the same. It is worthy o
k that mercury, whilst in the metallic state, i
ute of injurious properties, but if oxidised or other
rendered fit for absorption, it may give rise t
rous symptoms. Thus, workers in mercurial mine
much, as did those who were employed in silverin
g-glasses by the old process. Large doses (from hal
nd to two pounds) have been given in obstinate case

has been maintained until the sixth day, and in one instance (where between three and four scruples had been swallowed) until the twelfth day. It is probable that the average duration of fatal cases is from twenty-four to thirty-six hours.

Symptoms.—In the majority of cases the symptoms commence immediately, with an acrid metallic taste, often described as coppery, and a sense of constriction and burning heat in the throat and stomach. The burning pain gradually extends over the abdomen, and is much increased by pressure. There is nausea, with vomiting of the contents of the stomach. These matters are sometimes mixed with blood and stringy masses of mucus. The sickness is accompanied by diarrhœa or dysentery, swelling of the abdomen, and increased pain. The countenance becomes flushed and often swollen, though it is occasionally pallid and anxious; the lips and tongue get white and shrivelled; there is frequently some dyspnœa, while the pulse is small, or wiry and frequent; and death is preceded by faintness, cramps, insensibility, or convulsions.

Should these effects not prove rapidly fatal, the pain will gradually become lessened, though attacks of colic and nausea may come on at intervals for several days. Often the secretion of urine is almost, or even quite, suppressed. After a time there are symptoms of hectic fever, with much depression. The gums and salivary glands also become swollen, there is a coppery taste in the mouth, the breath is very fœtid, and there is severe ptyalism or salivation. This latter effect is the most prominent feature in the *chronic* form of poisoning, where small and frequently-repeated doses have been given: it often proceeds *to such an extent* as to cause death, when the patient would *otherwise* probably recover.

It must not be forgotten that salivation sometimes arises where no mercurial of any kind has been given. Thus arsenic, bismuth, lead, iodide of potassium, opium, &c., may induce it in some very peculiar constitutions. Small medicinal doses (as a few grains of calomel) may also excite it in certain susceptible individuals; and especially in persons suffering from renal disease. It may also occur spontaneously, as in stomatitis or inflammation of the mouth; and very troublesome examples of it may occur in pregnant women.

It is strange that neither in acute nor chronic mercurial poisoning do we observe any marked loss of muscular power. Yet workers in quicksilver (owing to the absorption of the fumes of mercury during respiration) are very apt to suffer from a peculiar kind of paralysis; which commences with inability to direct the hands and arms, and goes on to a shaking or trembling of all parts of the body.

Post-mortem Appearances.—The appearances produced by corrosive sublimate are confined chiefly to the digestive canal. The mucous membrane of the mouth, fauces, and œsophagus is softened and of a whitish or bluish-grey colour. The stomach also presents marks of violent inflammation; beneath the mucous membrane numerous patches of extravasated blood are seen, and frequently corrosion or ulceration has been found. The large and small intestines, the peritoneum, and especially the urinary organs, often appear inflamed. In many instances the bladder has been much contracted.

Treatment.—This must consist in the removal of the poison and the administration of antidotes. Vomiting is best promoted by administering copious draughts of fluids containing albumen; but if necessary ipecacuan may be

given. The white and the yolk of raw eggs with milk should be abundantly administered. Gluten has been much recommended, and may readily be prepared by washing flour in a muslin bag under a stream of water; but on an emergency it will be best to exhibit the flour at once, made into a paste with milk or water. The free use of demulcent drinks, milk, and ice will be very grateful to the patient's feelings. Gargles of alum or borax do some good. Opiates may be given in small doses, if there be much pain, and we should allow only a milk or farinaceous diet. Sucking chlorate of potash has been recommended to check the salivation. The most useful remedy, however, is the iodide of potassium; for this salt destroys the compounds formed by the union of mercury with certain of the tissues, and eliminates the poison through the kidneys.

Tests.—Corrosive sublimate is completely volatilised by heat.

1. Liquor potassæ added to its solution gives a yellow precipitate. This precipitate, if washed, dried, and heated in a test tube, gives a ring of metallic mercury in the form of globules in the cool part of the tube. In like fashion corrosive sublimate itself may be reduced and volatilised if heated with black flux.

2. On adding a solution of iodide of potassium to a small quantity of the solution, a bright scarlet precipitate, soluble in excess of iodide of potassium, is produced.

3. If a drop or two of a solution of corrosive sublimate, slightly acidulated with hydrochloric acid, be placed on a sovereign, and the solution and the gold be touched with a piece of *zinc* or an iron key, the mercury will be deposited *as a bright silvery* stain on the gold.

CALOMEL (*Subchloride* or Chloride of Mercury) is a

heavy white powder, which is usually regarded as a safe medicine. Yet, in some peculiar constitutions, it has caused excessive salivation and death, even though only a few grains have been given. In large doses it may be regarded as an irritant poison. It is distinguished from corrosive sublimate by forming a black precipitate with caustic potash and by its insolubility in water.

AMMONIO-CHLORIDE OF MERCURY (*White Precipitate*).—This substance is a chalky-looking powder, containing about eighty per cent. of mercury. It produces vomiting, purging, great pain in the stomach, cramps, and convulsions. Out of fourteen cases, collected by Dr. Taylor, in which from a few to forty grains were taken, only two proved fatal.

The remaining preparations of mercury, which in rare instances have been used as poisons, are the *Red Oxide of Mercury* (red precipitate); the *Red Sulphuret of Mercury* (cinnabar, or vermilion); the *Cyanide of Mercury;* the *Nitrates of Mercury;* and *Turpeth Mineral.*

Mercury may be separated from organic admixture by Reinsch's method.

CHAPTER XVIII.

PREPARATIONS OF LEAD.

LEAD, in its metallic state, is not injurious. It is, however, readily acted on by acids, exposure to the atmosphere, &c., and converted into carbonate of lead. The chief compounds of this metal which have been found to produce poisonous effects are the acetate, subacetate, and the carbonate.

ACETATE OF LEAD (*Sugar of Lead*).—This is sold

as a glistening white powder, or in the form of crystalline masses resembling loaf sugar. It is more frequently used as a poison than either of the other compounds. It is very soluble in water and has a sweetish metallic taste. Three or four instances are recorded in which recovery has taken place after an ounce of this substance has been taken in solution.

Mr. Bancks, of Stourbridge, has reported the particulars of a series of cases of poisoning by the acetate of lead (*Lancet*, 5th May, 1849). It appears that thirty pounds of this substance were accidentally mixed at the miller's with eighty sacks of flour. This was made into bread, from eating which 500 persons suffered severely. The chief symptoms were a sense of constriction in the throat and at the pit of the stomach, crampy pains round the navel, stiffness of the abdominal muscles, paralysis of the lower extremities, constipation, scanty urine, and the formation of a deep blue line round the gums. Although in many cases there was great prostration with other alarming symptoms, yet under the use of purgatives all recovered. It was noticed that after a temporary convalescence many of the symptoms returned in an aggravated form without any apparent cause. Sometimes there has been vomiting and purging, and there is great prostration, with cramps and convulsions.

Post-mortem Appearances.—They are not usually very distinct. The stomach and intestines have been found inflamed, and the surface of the former softened and, in the the case of animals, corroded. There may be no characteristic signs in chronic poisoning.

SUBACETATE OF LEAD (Goulard's Extract).—This substance is known to have proved fatal in three or four instances, after having caused great agony. It is a mo

powerful poison than the acetate. It is found in the shops as a whitish-coloured liquid.

CARBONATE OF LEAD (*White Lead, Ceruse, &c.*).—This is sold in heavy white masses, looking like chalk. It is readily acted on by acids, but is very insoluble in water.

Dr. Snow has reported an instance in which a child ate a portion, about the size of a marble, mixed up with oil; it died on the fourth day. Carbonate of lead derives its greatest interest from the chronic form of poisoning which it produces among white-lead manufacturers, painters, &c., known as "the painters' colic," which too often terminates in "lead palsy." In these instances the lead finds its way into the system by absorption from the digestive canal, the lungs, or the skin; producing its characteristic effects when a sufficient amount has been absorbed. It is this salt which is formed by the action of air and water upon lead.

The other preparations of this metal do not require any separate notice.

Treatment.—The sulphates of soda or magnesia should be freely given, dissolved in water. Milk, or milk and eggs will be useful. If vomiting is absent, an emetic of sulphate of zinc should be administered, or the stomach-pump may be advantageously employed.

For a chemical antidote in poisoning by carbonate of lead Dr. Taylor recommends a mixture of vinegar and sulphate of magnesia.

Tests.—The presence of a salt of lead in solution may be thus ascertained:—1. On passing sulphuretted hydrogen through it, or on adding a few drops of sulphide of ammonium, *a black precipitate* is given. 2. A white precipitate *results from the use* of liquor potassæ or liquor ammoniæ. 3. *Dilute sulphuric* acid gives a similar precipitate, which is

insoluble in nitric acid. 4. Iodide of potassium affords a bright yellow deposit (iodide of lead).

CHRONIC LEAD-POISONING.—The chronic and insidious effects produced by lead upon the constitution are deserving of careful attention. Water impregnated with this metal in its passage through lead pipes or cisterns, acquires poisonous properties. Lead-pigments are sometimes improperly used to colour cheese, lozenges, snuff, &c. The endemic colic of Devonshire was due to the absorption of lead contained in cider, which had been made in leaden vessels; and in the wine district of Poictou attacks of colic were so common, from the impregnation of wine with this metal, that we still speak of "colica Pictonum."

The pernicious influence of lead is manifested among those engaged in the manufacture or use of lead compounds, especially painters, lead smelters, plumbers, colour-grinders, shot manufacturers, workers in sugar of lead, potters, compositors, enamellers of cards, &c. These artisans should be advised to prevent disease by great cleanliness, by avoiding intoxicating liquors, and by drinking freely of sulphuric acid lemonade. The substitution of moist for dry grinding has proved useful.

The most prominent *symptoms* of chronic poisoning by lead are as follows: A blue line around the gums, and the liability of the latter to bleed from any slight cause; emaciation, a pallid tint of the complexion, poorness of blood, and a feeble quick pulse; obstinate constipation, with attacks of colic relieved by pressure; diminution of the renal secretion and rheumatic pains; afterwards comes weakness of the hands, wrists, and arms, ending in paralysis of the extensors, or "dropped wrists," creeping up the arms.

The treatment of these cases must consist in the first

instance in the use of purgatives; none being better than sulphate of magnesia with the dilute sulphuric acid. But the remedy of all others is the iodide of potassium, in five or ten grain doses thrice daily; this agent acting most beneficially when employed in conjunction with galvanism to the paralysed limbs.

CHAPTER XIX.

SALTS OF COPPER.

POISONING with the salts of copper is of comparatively rare occurrence; when it happens, it is generally the result of accident. The metal itself is not poisonous, but the action of the gastric juice may produce a very deleterious salt. Copper coins, when swallowed, sometimes on this account prove mischievous; though usually any ill effects which ensue are due to their mechanical action. Salts of copper have been accidentally introduced into the system by means of food which has been cooked in copper sauce pans. The most important substances of this class to the toxicologist are the following:

SULPHATE OF COPPER (*Blue Vitriol*).—Blue-stone is met with in large crystals, which are very soluble in water and possess an acrid metallic taste. In doses of half an ounce it acts as a powerful irritant. It has been administered to procure abortion. In the case of a child sixteen months old, who sucked some pieces of blue-stone *with which* she was playing, death occurred in four hours.

SUBACETATE OF COPPER (*Verdigris*).—This preparation *is met with in* masses, or in the form of a green *powder. It* possesses a powerful astringent meta

taste. It is often produced by allowing substances to stand in coppers. It has proved fatal in half-ounce doses.

ARSENITE OF COPPER (*Mineral Green*).—The effects of this salt have been already referred to.

Symptoms.—Pain in the epigastrium, gradually extending over the abdomen, violent vomiting—the vomited matters being of a blue or green colour—and diarrhœa, are the symptoms which set in the most speedily. Then there is usually dyspnœa, great depression, coldness of the extremities, headache with giddiness, and slight tetanic convulsions. Sometimes there is suppression of urine. Jaundice very frequently occurs—a symptom the more important, as it is rarely met with in most other forms of poisoning. Occasionally stupor, coma, and paralysis supervene. Should death ensue, it may occur within a few hours, or not for several days.

The salts of copper taken in very small doses, for several days, give rise to a metallic taste in the mouth, thirst, debility, cramps and colicky pains, with symptoms of dysentery. In some instances there has been found retraction of the gums with the formation of a purple line, very distinct from the blue mark due to lead.

Post-mortem Appearances.—Evidences of inflammation are usually found in the stomach and intestines, the mucous membrane being often ulcerated and of a blue-green colour. Particles of the poison may sometimes be found adhering to the coats of the bowel. Perforation of the intestines has occurred.

Treatment.—Vomiting sets in spontaneously, and is to be encouraged by the use of warm water. The stomach *pump will* rarely be needed. The only effectual antidote *is albumen.* The whites and yolks of several eggs shou

therefore be given, followed immediately by milk or mucilaginous drinks.

Tests.—Solutions of the sulphate and nitrate of copper are blue; the chloride is green. The salts of copper may be thus identified:

1. A polished knife or needle introduced into the solution is soon covered with a coating of copper.

2. Ammonia produces with a salt of copper a bluish precipitate, readily soluble in excess of ammonia, and forming a splendid blue solution.

3. Ferrocyanide of potassium gives a claret-coloured gelatinous precipitate, if the copper be abundant; otherwise the deposit is of a light brown.

4. Sulphuretted hydrogen gas yields a deep-brown precipitate.

5. A few drops of the copper solution are to be placed on platinum foil, and slightly acidulated; on touching the foil, through the solution, with a strip of zinc, metallic copper is deposited on the platinum.

CHAPTER XX.

SPECIFIC VEGETABLE IRRITANTS.

LABURNUM (*Cytisus laburnum*).—Every portion of this plant is poisonous. The seeds are frequently eaten by children, and give rise to vomiting and purging, with dilatation of the pupils, rigors, rigid limbs, &c.

Œnanthe crocata, *Phellandrinum aquaticum*, *Æthusa Cynapium* &c., strictly speaking, belong to this group.

BLACK HELLEBORE (*Helleborus niger*) or *Christmas Rose, grows in shady* woods, and bears a large flower in *January.* The leaves and root when eaten give rise to *abdominal pain,* vomiting and purging, vertigo, cold sweats

and collapse, resembling that of malignant cholera. An infusion of this plant is sometimes administered by quacks to destroy intestinal worms. It has proved fatal to children under these circumstances.

Several other substances variously grouped for the sake of convenience should come under this heading.

CHAPTER XXI.

SPECIFIC ANIMAL IRRITANTS.

CANTHARIDES (*Spanish Flies*).

THIS poison is well known, and is usually administered in the form of powder or tincture. Of the former, twenty-four grains have destroyed life; of the latter, one ounce. This poison has been employed as an aphrodisiac and to induce abortion, by persons ignorant of its dangerous effects. This is, perhaps, the most frequent cause of poisoning by cantharides. Applied externally it has proved fatal, as in the case of a girl affected with scabies, who anointed the whole of her body with cantharides ointment in mistake for that of sulphur. She died in five days, after suffering from the symptoms of poisoning by cantharides.

It produces an acrid taste, vomiting, purging, burning heat in the stomach, pain in the loins, severe strangury, bloody urine, and priapism. Then there is faintness with giddiness, the limbs become rigid, and delirium with convulsions precede death. Sometimes the matters ejected from the stomach or passed in the stools contain shining *golden or green* particles, the remains of the wing cases of *the beetles*, which constitute the drug, readily seen with a *lens*, or even with the naked eye.

After death, marks of inflammation are found in the alimentary canal, kidneys and bladder, and the genital organs.

Test.—The detection of Spanish flies, if taken solid, depends mainly on the presence of the shining particles already alluded to, in the stomach, or in the vomited matters. To make their nature certain, however, an extract of the suspected materials should be prepared and treated repeatedly with chloroform or ether. This fluid is to be allowed to evaporate till only a few drops are left, which may be applied on lint to some portion of the body where the skin is fine, as the fore arm, the part being covered by a bit of isinglass plaster, or goldbeaters' skin. The vesication produced is the test of the presence of cantharides.

No antidote is known. Vomiting must be excited or encouraged; and linseed tea, and gum water, or gruel copiously administered. The warm bath will afford great relief. Oil must be avoided, on account of its being a solvent of the active principle (cantharidine) of this poison.

IV.—NEUROTIC POISONS.

CHAPTER XXII.

NARCOTICS.

NEUROTICS, ACTING ON THE BRAIN AND PRODUCING SLEEP.

OPIUM.

OPIUM is the inspissated juice of the unripe capsules of the *Papaver somniferum*, or white poppy, and is a very complex substance. Its principal properties, however, are due to the presence of *morphia*, as meconate of morphia; but others of its constituent substances undoubtedly modify its action.

It is sometimes used as a poison in its crude state, but more frequently in solution in alcohol, forming tincture of opium, or laudanum. Unfortunately, opium is the powerful ingredient of most soothing syrups for children, to whom opium is at all times especially dangerous; and many who do not die from its direct effects, do from the wasting indirectly produced.

Of domestic quieting physic the chief preparations are Godfrey's Cordial, supposed to consist of one grain of opium in two ounces; and Dalby's Carminative, which is one-fourth weaker.

The smallest quantity of *laudanum* which is known to have proved fatal to an adult is two drachms, from which death occurred within twelve hours. The exact quantity *taken was*, however, doubtful. Two grains and a half of *the extract*, a quantity said to be equal to four grains

crude opium, have produced a similar result. Much larger doses are, however, taken with impunity on many occasions, more especially by those habituated to the use of this drug, who remain almost unaffected by surprisingly large quantities. De Quincey, the English opium-eater, once found in a pirated edition of 'Buchan's Domestic Medicine,' a caution against taking more than "twenty-five *ounces*" of laudanum at one dose. He says that he always bore this *excellent* advice in mind; and it does not appear that he ever took more than sixteen ounces of the tincture of opium as his daily allowance. In certain diseases, patients quite unaccustomed to the use of sedatives can take excessive amounts without narcotism being produced. In some cases of tetanus, for example, upwards of four ounces of laudanum have been given daily for a week, without any marked effect.

On the other hand, it must not be forgotten that not a few individuals are unable to take even one-third of a grain without becoming narcotised. Young children are particularly susceptible of its effects; the tenth and twelfth parts of a grain having respectively proved fatal to infants two and five days old. Dr. Edward Smith has even recorded the case of an infant seven days old, who died comatose eighteen hours after having had administered to it about the twelfth of a grain of opium, or the quantity contained in one drop of laudanum.* The smallest fatal

* Considering the reprehensible way in which pseudo-medical advice is given in some newspapers and cheap periodicals, it is only surprising that more cases of poisoning do not occur. Take *the following example* (*Sunday Times*, 3rd October, 1847), of a *cure for dysentery*: "Half a noggin of logwood, well boiled and *strained, half a glass* of port wine, and twenty drops of laudanum, *have proved successful* in checking dysentery in adults. For *children only fifteen* drops of laudanum should be used."

dose for a child on record is one of paregoric elixir equivalent to about one-*ninetieth* of a grain of opium. On the other hand, they sometimes recover from very large doses indeed.

The duration of a fatal case is generally from seven to twelve hours. The shortest period recorded is three-quarters of an hour; the longest, twenty-four hours. If the patient survives twelve hours there is good hope of recovery.

The quantity of MORPHIA found in opium varies from two to ten per cent. The chief salts of this alkaloid are the *acetate*, the *hydrochlorate*, and the *sulphate*, all being very energetic poisons. They cause symptoms similar to those about to be described as produced by opium. But, in addition, there has been especially noticed great itching of the skin, convulsive twitchings of the muscles of the face and limbs, and occasionally tetanus. Small doses of any of the salts of morphia may cause death. In a delicate woman half a grain is supposed to have proved fatal; in several instances one grain has proved fatal; and certainly a dose of two grains might kill a healthy adult unaccustomed to opiates. Nevertheless, under the influence of custom, large quantities may be taken. A young lady, who has long been under notice, has for the last three years taken daily fifteen grains of the hydrochlorate of morphia, without obtaining more than two or three hours' sleep from it; while for many days in succession, when suffering much pain she increases the quantity to one scruple. From attempts to diminish the dose, made without the patient's knowledge, only mischief has resulted.

Others of the opium alkaloids are poisonous; but instances *of* poisoning by their means have not occurred *except one* doubtful instance of poisoning by narcotine *recorded by* Sonnenschein.

Symptoms.—When a large dose of opium or its tincture has been taken the symptoms usually manifest themselves in about twenty or thirty minutes. They commence with giddiness, drowsiness, and stupor; then ensues insensibility. The patient appears as if in a sound sleep, from which he can be roused by a loud noise, &c., although he quickly relapses. As the poisoning progresses the breathing becomes slow and stertorous, the pulse weak and feeble, and the countenance livid. The eyes are closed, while the pupils are generally contracted, often almost to the size of a pin's point, and insensible to the stimulus of light. In some instances the skin is cold and livid, in others it is bathed in sweat. So also the countenance may be either ghastly or placid, the pupils may even be dilated, and the pulse may be unaffected, or so small and frequent as to be scarcely appreciable. Vomiting sometimes occurs, with slight reaction, so that hopes of recovery are entertained. But frequently there is a relapse, the comatose state returns, and death quickly follows, occasionally preceded by convulsions.

The possibility of rousing a patient during the earlier portion of the progress of these symptoms will assist in diagnosing the effects of poisoning by opium from those due to apoplexy, epilepsy, &c. The contracted condition of the pupil will also assist; but it must not be forgotten that in lesion of the pons Varolii the pupils are also contracted. When permanent recovery ensues it is complete; but it is usually preceded for a day or two by severe nausea, a sense of weariness, constipation, and *headache.*

The habitual use of opium is most injurious. Dr. Oppenheim, *in his* description of the state of medicine i*n Turkey, tells us that* persons seldom attain the age of for

who have begun the practice early. The opium-eater may be known by his attenuated body, withered yellow countenance, stooping posture, and glassy, sunken eyes. He has no appetite, his bodily powers are destroyed, and he is obliged continually to increase the dose of his "grief-assuaging remedy" to obtained the wished-for effect.

Post-mortem Appearances.—The appearances in acute poisoning by opium are not very characteristic. The most prominent are, great turgescence of the vessels of the brain, with effusion of serum into the ventricles and at the base. The turgid condition of the vessels often continues down the spinal cord, &c. The lungs are usually gorged with fluid blood, and the skin is of a livid hue.

Treatment.—The first object is to remove all the poison from the stomach, and this cannot be effected in any way so well as by the stomach-pump. In the absence of this instrument, emetics of half a drachm of sulphate of zinc, or a table-spoonful of mustard, must be employed. The patient at the same time is to be prevented as far as possible from going to sleep. When the stomach has been thoroughly emptied, every means must be adopted to keep the patient roused. This is to be effected by dashing cold water over his head and chest, walking him up and down, or shaking him between two attendants in the open air, irritating his legs by flagellation with a wet towel, applying electro-magnetic shocks to the spine, and administering strong coffee. Bleeding has been recommended; but it is only to be used after the poison has been removed from the stomach, and when from the coma and full pulse we are sure that there is cerebral congestion. In extreme cases artificial respiration must be tried.

The remedies recommended must be perseveringly used, *remembering* that as long as life lasts hope of recovery is

not to be banished. In the great majority of cases the treatment is successful.

Tests.—There are no direct means by which opium may be detected. We endeavour therefore to obtain evidence of the presence of morphia and meconic acid. The two substances may be separated from organic admixture by the following process: The suspected matters should be well boiled with distilled water, and spirit acidulated with acetic acid, and strained. To the fluid which has passed through, acetate of lead is to be added until precipitation ceases, and the whole, after standing, is to be thrown on a filter. The insoluble meconate of lead remains on the filter, the morphia passing through as acetate. To separate the meconic acid the substance on the filter is to be diffused through water, and sulphuretted hydrogen passed for a time. Sulphide of lead is thus thrown down and may be separated by filtration, the meconic acid remaining in solution. On concentration this should give the requisite reactions.

In the search for morphia the filtered fluid above referred to is also to be treated with sulphuretted hydrogen, to secure the precipitation of all acetate of lead, &c., which is next to be carefully separated from it by further filtration. The fluid now passing through, containing the acetate of morphia, is next to be concentrated by evaporation over a water bath, and carefully neutralised by bicarbonate of potass, if it be desired to obtain the pure alkaloid; but this is not necessary, as the acetate responds to all reagents; The acetate may be dissolved out of the mass in dilute alcohol (it is not soluble in ether), again filtered, the filtrate being finally evaporated to dryness and tested.

MORPHIA.—The best tests for this alkaloid, in substance or in solution (substance is preferable) are:

1. Nitric acid, which strikes an orange red colour, varying in intensity with the strength of the acid and the concentration of the morphia solution. Ruddy fumes are also developed.

2. Neutral perchloride of iron, strikes a rich blue colour with morphia when added in small quantity; if added in excess, the yellow of the test, combining with the blue, may produce a green. This blue is destroyed by acids and by heat. Nitric acid not only destroys the blue produced by this test, but replaces it with the orange-red colour; so that the nitric acid test may be applied to the same portion of morphia after the iron test, but not *vice versâ*.

3. Iodic acid. This acid becomes decomposed, owing to the reducing action of morphia, setting free the iodine. The latter is detected by its brown colour, and the blue which it strikes with starch. The iodic acid should be previously tested to ascertain its purity, as it occasionally contains free iodine.

4. Bichromate of potassium gives a green with morphia, passing to a dingy brown.

MECONIC ACID.—This is obtained from solutions of opium, in the form of little scaly crystals of a reddish tint, which are decomposed by heat and partly sublimed. In solution it may be detected by its acquiring a blood-red colour on the addition of the perchloride of iron. A similar colour is produced by sulphocyanide of potassium, as found in the saliva; but the colour of the meconate is not discharged by chloride of gold; the sulphocyanide is.

NARCOTINE dissolves in sulphuric acid with a yellow colour, converted into a carmine red by the addition of a *trace of nitric* acid.

CHAPTER XXIII.

ANÆSTHETICS.

NEUROTICS ACTING ON THE BRAIN AND PRODUCING INSENSIBILITY.

CHLOROFORM—CHLORAL—BICHLORIDE OF METHYLENE —ETHER—AMYLENE—NITROUS OXIDE.

THE anæsthetics which have hitherto been employed in the practice of medicine are chloroform, sulphuric ether (or a mixture of these), bichloride of methylene and nitrous oxide, and amylene. Any of these agents may cause death when introduced into the system by inhalation.

CHLOROFORM is a colourless, heavy, volatile liquid; having a fruity ethereal odour and a sweet pungent taste. It is formed by the union of chlorine and marsh gas, but more commonly by the action of bleaching powder on ethylic or methylic alcohol. It is readily soluble in alcohol, but very sparingly so in water. Chloroform is a good solvent of caoutchouc, gutta-percha, camphor, wax, resin, some of the alkaloids, &c.

The *symptoms* produced by the vapour of chloroform may be divided into three groups of varying intensity; briefly they are these: First, a degree of relief from pain, the senses being but slightly affected; second, a stage of *excitement and incoherence*, wherein the patient is prone to *struggle; and thirdly*, a stage of which the most marked *features are complete* insensibility and narcotism, with r *laxation of the* muscular system. At first the patient

conscious of all that is passing around him, but there is dizziness and singing in the ears. Then the mental functions are impaired, there is often excitement, the saliva is increased, the patient pushes away the inhaler, rigidity and spasms of the muscles may occur, and there is incoherent talk. In the next stage there is insensibility to pain, and the conjunctiva may be touched without causing flinching. If the use of this anæsthetic be pushed further the breathing becomes stertorous, the muscles quite relaxed, and the pupils dilated; while a still further increase of the chloroform embarrasses and then stops the breathing and arrests the heart's action.

Many cases of death from the vapour of chloroform have occurred, the fatal effect sometimes happening very rapidly from shock, syncope, or convulsions. The vapour of only thirty drops has destroyed life in one minute. Death under the influence of chloroform must not be confounded with death from its effects. The smallest fatal dose when the drug has been swallowed is one drachm in a boy aged four.

The effects of chloroform taken by the mouth are of the same description as those which follow the inhalation of this agent; with this exception, that the fatal result seems to be longer deferred. A case reported in the *Medical Times and Gazette*, 10th May, 1862, illustrates the symptoms, &c., in a clear way. Mr. M., thirty-four years of age, a highly-gifted restless man, was in the habit of inhaling chloroform on account of sleeplessness. He was very sensitive to its action. At about 12.30 A.M. on the 7th October, 1861, he drank some chloroform; the quantity being uncertain, *though* it may be inferred that it was about one *ounce*. At 7.15 he was in such a profound sleep that *his wife* felt uneasy, and she sent for Dr. Axel Lamm

This gentleman found his patient in a tranquil sleep, the respiration being somewhat hurried and audible, the pulse full but slow, the body warm, and the pupils dilated and insensible. There was a perceptible smell of chloroform in the breath and in the air of the room. The window was opened, ice was applied to the head, cold affusions were used along the spine, and an enema was administered. At 9.30 A.M., the patient was paler, breathing less audibly, and with a weaker pulse. Artificial respiration was employed by means of electricity, an ammonia lavement was given, and aspersions of iced water to the chest and pit of the stomach were used alternately with warm coverings. The stupor continued, the respired air smelt distinctly of chloroform, the abdomen was tympanitic, and the pupils began to contract. About 9 P.M. the eyes began to move, the pupils seemed sensible to light, the pulse was 160, there was abundant perspiration, and the patient sat up for a few moments and looked surprised. Exhaustion, however, set in, and death occurred just before midnight, nearly twenty-four hours after swallowing the poison.

A second interesting case (*Medical Times and Gazette*, 31st May, 1862) also deserves attention. A gentleman, fifty years of age, swallowed two ounces of pure chloroform at 8 A.M. He was not seen until 3 P.M., when he was found in a state of deep coma. His breath smelt strongly of chloroform, the pupils were widely dilated and insensible, the pulse slow and feeble, the surface colder than natural, the movements of the thorax scarcely *perceptible*, and sensation generally abolished. Ammonia, *sinapisms*, *bottles* of hot water, and cold affusion did no *good*; *but on* using a stomach-pump a quantity of chloro*form mixed with* watery mucus was withdrawn, and in

less than an hour the patient was able to answer questions. For three or four days he complained of a burning sensation in the throat and epigastrium, and then got well. A consideration of the treatment employed in this instance cannot but suggest the idea that the first patient might have had a better chance of recovery had the stomach-pump been used when Dr. Lamm was first called in; though it is difficult to conceive how any quantity of chloroform could remain in the stomach for seven hours, without all of it being absorbed.

Various plans have been suggested for the administration of chloroform with safety, but this must be remembered: the use of anæsthetics is at all times attended with risk, and we can only at best diminish the danger. Apparatus may be used so as to reduce the risk to a minimum; but this is plain, any contrivance which in itself requires much attention, and thereby diverts it from the patient, is bad. More lives have been lost by bungling in its administration than from the noxious character of the drug.

In the *treatment* of poisoning by the vapour of any of the anæsthetics mentioned in this chapter, we must expose the patient to a current of pure air, use cold affusion, and employ artificial respiration until the poison is eliminated. Galvanism may be employed to keep up the action of the diaphragm, either directly or through the phrenics. As these agents are got rid of through the lungs, the purity of the expired air is one test of the elimination being complete; though of course inferior to the evidence afforded by the subsidence of the symptoms. In poisoning by liquid chloroform or ether the stomach-pump ought to be promptly used.

CHLORAL HYDRATE, which with an alkali is converted *into chloroform*, has of late been much used as a narcotic and

for easing pain. No details of any case of poisoning by it agency have yet been published.

BICHLORIDE OF METHYLENE has been used for anæsthetic purposes. It is supposed to be safer than chloroform Practically they act much alike, and death happens with the one as with the other.

Test.—Chloroform at a red heat is decomposed, and chlorine and hydrochloric acid are formed. Hence, to detect it the substance supposed to contain it may be heated so as to expel the chloroform, which should be conducted away from it by a tube at right angles; to this heat should be applied sufficient to decompose the vapour, and its product searched for by the ordinary tests. The smell is a valuable criterion.

SULPHURIC ETHER.—Sulphuric ether, or ether, is a clear colourless liquid, very inflammable, soluble in alcohol and less so in water. It is usually obtained by distilling common alcohol with sulphuric acid.

The effects produced by the inhalation of ether are similar to those which result from chloroform. It is, however, without doubt a much safer agent, but its effects are longer in manifesting themselves; it is more irritating to the air-passages, and much more of it is required. Death have occurred under its influence as under that of chloroform.

AMYLENE.—This is a colourless, volatile liquid, made by distilling amylic alcohol (obtained from crude fusel oil or oil of potato spirit) with chloride of zinc.

Dr. Snow found that amylene, like chloroform, is capable *of causing sudden death by inducing over-narcotism of the heart, and paralysis* of this organ. He had two deaths *from it, and it has since* been entirely given up as *anæsthetic.*

NITROUS OXIDE.—Comparatively recently the laughing gas of Sir Humphrey Davy has been introduced as an anæsthetic agent. Its successful use depends on the total exclusion of air from the lungs during its exhibition. It can only be used for a short time, hence it is chiefly employed in dental operations, although it has been given for a considerable length of time consecutively by allowing the patient to return to the verge of sensibility before giving a fresh dose.

CHAPTER XXIV.

INEBRIANTS.

NEUROTICS ACTING ON THE BRAIN AND PRODUCING INTOXICATION.

ALCOHOL—NITRO-BENZOLE—COCCULUS INDICUS—FUNGI, ETC.

ALCOHOL.—Spiritous liquors, when taken in large quantities, not unfrequently produce fatal effects.

Two wineglassfuls of brandy proved fatal to a boy, seven years old, in thirty hours. Dr. Taylor mentions the case of a man who drank two bottles of port wine (containing eleven ounces of alcohol) in less than two hours. He speedily became intoxicated and utterly helpless, never rallied, and died from congestion of the brain and lungs Another man who swallowed a bottle of gin for a wager died in half an hour, although much of the spirit was removed by the stomach-pump. A common cause of acute alcoholic poisoning is "sucking the monkey," as practised in the docks by labourers having access to spirit casks.

The *symptoms* generally come on rapidly, the individual appearing confused, and unable to walk steadily. This degree of intoxication soon passes into the stage of complete stupor and coma, and unless there is vomiting collapse soon sets in. In some cases a remission of the symptoms has occurred, death being postponed for a day or longer.

As the alcohol is eliminated by the lungs, stupor from drink may be detected by the odour of the breath. The countenance is usually flushed, and the pupils are dilated, but in cases of acute poisoning the patient may be deadly pale. The pupils are not contracted, as in poisoning by opium; moreover, the individual may generally be roused for a few

moments by a loud noise, &c.; a circumstance which may prevent intoxication being mistaken for concussion of the brain.

Diluted spirits produce a state of excitement, terminating in stupor. It must be remembered that alcoholic liquids have been frequently made the vehicles of more virulent poisons.

As regards *treatment*, it is only necessary to say that the poison is to be removed as quickly as possible by the stomach-pump. Cold affusion should be employed, and the diluted liquor ammoniæ, or carbonate of ammonia, administered. Subsequently warmth must be promoted.

NITRO-BENZOLE AND ANILINE.—A compound, made from the rectified products of coal tar and nitric acid, and known as *nitro-benzole*, is sometimes used as a substitute for essential oil of almonds. It is sold to perfumers under the name of "essence of mirbane." A lad employed in some chemical works in the early part of 1862, finding a syphon did not act, sucked through it some of the fluid, which happened to be nitro-benzole. No immediate effect resulted, but in a few hours he felt as if he were drunk. Stupor came on, and ended in death twelve hours after swallowing the poison. Another product of the destructive distillation of coal in gas-making is *aniline* (into which nitro-benzole is converted in the human body) a colourless, limpid, acrid, and poisonous liquid. It has given rise to very alarming symptoms when swallowed, as well as when inhaled in vapour. It produces a remarkable blue or purple discoloration of the body, particularly the lips and nails.

COCCULUS INDICUS.—The kernel of the berry of the *Menispermum* cocculus, or Levant nut, imported from the *East Indies*, contains from one to two per cent. of a poison

ous principle named *picrotoxine*. Thieves sometimes mix a decoction or extract of the berries with spirits or beer, to give these drinks an intoxicating property (hocussing). Dishonest publicans, too, first reduce their beer by means of salt and water, and afterwards give it intoxicating properties by adding cocculus extract. The same substance is used by poachers to destroy fish. The symptoms produced appear to be a peculiar stupor, a complete loss of voluntary power, with a consciousness of passing events.

DARNEL SEEDS (*Lolium temulentum*).—The seeds of this plant, which is often found growing with corn crops, when accidentally mixed in considerable quantity with wheat or rye, and ground into flour, have caused gastric pain, severe giddiness, vomiting, and other symptoms of intoxication. The sufferers complained that everything seemed of a green colour. A wet season is said to encourage the growth of darnel with the varieties of corn.

CAMPHOR.—This substance is very variable in its action. It has given rise to alarming symptoms on some occasions, and once it has destroyed life. In scruple and half-drachm doses, it seems to have produced giddiness, difficulty in walking, dimness of sight, difficulty of breathing, delirium, and insensibility.

The stomach-pump or emetics must be employed. If the effects are not very severe they will generally cease spontaneously after a time. The odour would lead to the detection of the poison.

FUNGI.—According to Berkeley there are now upwards of 2380 recognised species of British fungi, a considerable proportion of which are doubtless poisonous. But the type of the class may be taken as the Amanita muscaria. This is an autumn fungus of an orange-red colour, and is

used among the Siberian tribes, especially the Koraks, as an intoxicating agent, and produces symptoms somewhat similar to those of alcohol.

The Agaricus campestris and esculentus are those most frequently used as articles of food, on account of their savory properties; but even these are indigestible. They occasionally produce diarrhœa, with a pruriginous or exanthematous rash in dyspeptics; and should only be eaten in great moderation.

Ketchup, the juice of the mushroom flavoured with salt and spices, has produced faintness, nausea, and colic, lasting for some hours.

There are no very positive characters by which the wholesome fungi can be distinguished from the unwholesome. Moreover those which may be eaten with impunity by some individuals prove destructive to others. Thus, a French officer and his wife died from breakfasting off mushrooms which others in the house ate without inconvenience. As a general rule highly coloured mushrooms, with an astringent styptic taste, a forbidding pungent odour, and which grow in dark and shady places, should be avoided.

The symptoms produced by poisonous fungi are not unfrequently those indicative of gastro-intestinal irritation, with a disordered condition of the nervous system, and considerable depression; but, again, they may act much more like pure narcotics. In treating these cases, the stomach and intestines must be thoroughly emptied, and then the prominent symptoms are to be relieved according to their urgency.

HYOSCYAMUS—BELLADONNA—STRAM(ALBA—NIGHTSHADE.

MOST of these are not very important : have rarely been employed as poisons Serious symptoms have, however, result dental use.

HENBANE (*Hyoscyamus niger*).—All are poisonous; but the seeds are more p root or leaves. In medicinal doses it cotic. It owes its powers to an alkaloi contains.

In very large doses henbane produces g excitement, and a sense of weight in th tremble, and there is general loss of p get dilated, there is double vision, flashi

asylum. They rang the bell for matins at midnight; and those who attended were unable to read, or they read that which was not in the book. In another reported case (*Edin. Med. and Surg. Journal*, p. 562, October, 1844), the roots were put into soup, of which nine persons partook. Although no unpleasant flavour was noticed at the time of eating, yet very shortly afterwards all complained of an acrid taste, nausea, indistinctness of vision, restlessness, delirium, and great somnolency, which continued some time.

The appearances found after death consist chiefly of great congestion of the venous system. The lungs and brain have especially been found loaded with dark-coloured blood.

To prevent a fatal result from the use of henbane or others of this group, we must trust to stimulant emetics, as sulphate of zinc, and full doses of castor oil, so as to get rid of the offending substance.

Test.—The only test for hyoscyamus is the botanical characters of the plant, when taken in substance, and its power (common to all in this group) of dilating the pupil.

ATROPA BELLADONNA (*Deadly Nightshade*).—Two other plants known under the name of Nightshade will hereafter be referred to. The Deadly Nightshade, now to be noticed, is indigenous, and grows in woods and gardens. The root, leaves, and berries are poisonous, this property being due to the presence of an alkaloidal principle—*Atropia*.

Symptoms.—Dryness of the mouth and throat, thirst which nothing allays, nausea and vomiting, great dilatation of the pupils with indistinct or double vision, giddiness, palpitation of the heart, physical and mental depression, perversion of the sense of taste, and delirium followed by

stupor, form the chief symptoms. They may set in within from half an hour to three or four hours of swallowing the poison. Sometimes strangury and bloody urine, a scarlatinal kind of rash upon the skin, a disposition to laugh and talk wildly, fanciful delusions, a rapid flow of ideas, and difficulty in walking, have been observed.

A large detachment of French soldiers, halting near Dresden, ate freely of the belladonna berries. Shortly afterwards they were seized with nausea, thirst, dryness of the throat, difficult deglutition, insensibility of the eye, great dilatation of the pupil, delirium, and coma. Many of the men died before assistance could be rendered to them.

Post-mortem Appearances.—Congestion of the cerebral vessels, dilated pupils, red patches at different parts of the alimentary canal, and a dyed purple hue of the gastric mucous membrane, if the berries have been eaten, are the most common appearances.

Treatment.—Stimulant emetics, castor oil, and animal charcoal are the remedies to trust to.

Dr. Taylor refers to one case in which a young man poisoned himself with two grains of *atropia*. He took the dose on going to bed, was heard to snore heavily during the night, and was found dead at seven o'clock in the morning.

As a means of diagnosing poisoning by belladonna it has been recommended to introduce a few drops of urine into the eye of an animal, to see if dilatation of the pupil takes place.

Test.—There is no very certain test for *Atropia* beyond its effects on the pupils and on vision.

STRAMONIUM (*Datura Stramonium*, Thorn-Apple) is an indigenous plant found in waste places. The fruit and seeds are the most poisonous parts of the plant. The active

alkaloid, named Daturia, has properties resembling those of atropia, with which it would seem to be almost identical.

The poisonous effects of stramonium are the same as those of belladonna, and are to be relieved by similar remedies. When this drug is prescribed as a medicine it should be immediately discontinued if it produce dryness of the throat and dilatation of the pupils.

Dhatoora.—In India the seeds of the Datura alba, a plant which grows abundantly in most parts, are frequently used for the purpose of hocussing travellers, in order that they may be robbed with impunity. The seeds, which closely resemble those of the capsicum, are mixed with food, and give rise to total insensibility on the part of the recipient, often with noisy delirium or delusions. Death is not unfrequent after a large dose, although it would seldom seem to be administered for that purpose. Its effect may be for the time being to completely alter the disposition of the individual, and to cause him to give way to all kinds of foolish notions and antics.

NIGHTSHADE.—The *Solanum dulcamara* (Bitter-sweet, or Woody Nightshade) and the *Solanum nigrum* (Garden Nightshade) contain an active principle known as Solania. The red berries of the first-named plant, and the black berries of the second, have been eaten by mistake; and have given rise to great thirst, headache, giddiness, dimness of vision, dilated pupils, convulsions, vomiting, and purging. Orfila relates the cases of three children who died from eating the berries of the Solanum nigrum, after suffering from vertigo, dilated pupils, nausea, colic, stertorous breathing, and convulsions.

CHAPTER XXIII.

CONVULSIVES.

NEUROTICS PRODUCING CONVULSIONS.

NUX VOMICA—STRYCHNIA—BRUCIA.

THE plants which yield the alkaloid Strychnia are, the *Strychnos nux vomica*, a native tree of Coromandel, Ceylon, and Bengal; the *Strychnos Ignatii*, which abounds in the Philippine Islands, and furnishes the hard seed, about the size of a filbert, known as the bean of St. Ignatius; the *Strychnos tieute*, a large climbing shrub of Java; the *Strychnos toxifera*, of Guiana; and the *Strychnos colubrina*, or *Snakewood*, of the East Indies. The effects of these plants are exerted upon the spinal cord; as is manifest by the violent convulsions and the tetanic contractions of the muscles which they produce. They have no effect on the brain, consciousness remaining intact until death.

A powerful juice, used by the Indians of Guiana as an arrow poison, and variously designated as *curare*, *woorara*, &c., is in all probability obtained from the Strychnos toxifera. The composition of the arrow poison varies in different tribes; in some it is a mysterious compound of many substances, obtained from plants, red and black ants, *and the fangs of* venomous snakes; but in all the active *ingredient would* seem to be the Strychnos toxifera. It *destroys the* power of the motor nerves—an action the *reverse of* that possessed by strychnia.

NUX VOMICA.—A powder, a tincture, and an extract, obtained from the seeds of the Strychnos nux vomica, or koochla tree, are used in medical practice. Thirty grains of the powder have proved fatal, and so have three grains of the alcoholic extract. Death may occur in from fifteen minutes to twelve hours. It is possible that nux vomica may accumulate in the system, as serious symptoms have arisen from the long-continued use of small doses. Thus a lady took nine grains of the powder daily, in divided doses, for sixteen days. As purging then set in with colic, the medicine was withdrawn. Five days after the withdrawal there was ringing in the ears, with drowsiness, impairment of speech, &c.; on the ninth day tetanic symptoms set in, with trismus; and on the twelfth day, after several tetanic convulsions, death took place from exhaustion.

BRUCIA.—The seeds of the nux vomica not only yield strychnia but brucia, an alkaloid which has the same properties, and causes the same symptoms as strychnia, though it is much less powerful.

STRYCHNIA.—This alkaloid may very justly be termed a deadly poison. It is unfortunately the active ingredient of some preparations sold to the public for destroying vermin: a circumstance which has now led to the death of several individuals. 'Battle's Vermin Killer' is said by Dr. Letheby to consist of flour, Prussian blue, sugar, and strychnia in the proportion of twenty-three per cent. Since the use of strychnia by those notorious criminals Palmer and Dove, this formidable agent has been employed by other murderers.

The medicinal dose of strychnia is from the $\frac{1}{30}$th to the $\frac{1}{15}$th *of a grain twice* a day. Dr. Christison communicated a case *to Dr. Taylor* in which the $\frac{1}{10}$th of a grain caused the death *in four hours* of a child between two and three years

and three-quarters were the limits respect

Symptoms.— The time at which the s
mence varies according as the strychnia h
solution or in a pill. In the first case a
is experienced during swallowing, usually f
minutes by a sense of suffocation and difficu
Then there are twitchings of the muscle
ments of the limbs, and a quivering of t
The limbs become rigid, the head is bent
body is stiffened and arched, so that it re
and heels (opisthotonos). The difficult
causes the face to become dusky, the eye
and the lips livid. The features assume
(risus sardonicus); there is much thirs
inability to drink from spasm of the jaws
ferer is quite conscious, is much alarmed,
with the idea that death is surely stealing

an attack, or exhausted during an interval, in about two hours from the beginning of the symptoms.

When the strychnia has been taken in a pill two hours have elapsed before any effects have been produced. A case is also reported (*Glasgow Medical Journal*, July, 1856) where a medical man took three grains of strychnia dissolved in spirits of wine and diluted sulphuric acid. He went to bed and slept for an hour and a half, and then awoke with a spasm. Under treatment he recovered.

There is commonly a wide difference between tetanus arising from a wound or from disease and that provoked by strychnia. In the former case some exciting cause can be detected; the symptoms come on gradually, and only attain their full development at the end of several hours; the rigidity of the muscles is more or less permanent, there being no intervals of relaxation as there are in poisoning; and death has hardly been known to occur in less than twenty-four hours, while frequently it is deferred for two or three days.

Post-mortem Appearances.—Although the body may be relaxed at the time of death it usually quickly stiffens—frequently in the course of ten or fifteen minutes. The rigor mortis is persistent for some time: in the case of Cook, poisoned by Palmer, the rigidity of the body and limbs was said not to have passed off after two months' interment. This is not, however, invariable, as a body may be flaccid or stiff after death from this cause as from any other. The hands are often clenched, and the soles of the feet arched and inverted. The membranes of the brain and of the upper part of the spinal cord are congested; and there is often considerable serous effusion under the spinal arachnoid. The lungs are generally loaded with dark fluid blood. The heart is usually contracted, but sometimes the

right cavities are distended like the pulmonary vessels. The blood has been found black and liquid.

Treatment.—Emetics are to be given at once, and repeated until very free vomiting is induced. If the tetanic spasms have not commenced, the stomach-pump ought to be used. Chloroform is to be given to relieve spasm and pain, but the patient should be disturbed as little as possible, as the least thing induces the tetanic attack. There is no very suitable antidote, but tannic acid, in the form of green or black tea, &c., might be given.

Iodine forms a crystallisable compound with strychnia. Dr. Bennett, of Sydney, has recorded an instance in which he attributed recovery to the employment of tincture of iodine. Hence from thirty minims to a drachm of this tincture combined with the iodide of potassium may be exhibited. In its absence, three or four ounces of animal charcoal, diffused through water, ought to be given.

To prevent the spasms by paralysing the motor nerves, a solution of curare has been recommended by Dr. George Harley to be injected under the skin; or, if it could be obtained, the active principle of this substance, curarina, would perhaps be deserving of trial.

The patient is to be kept warm and quiet.

To separate strychnia from organic admixture the process modified from Stas, given in the beginning of this book, is the most useful.

Tests.— Strychnia is a white crystalline solid, very insoluble in water, soluble in alcohol or chloroform or weak acids, and having an intensely bitter taste.

1. Pure strychnia is not changed in colour when treated with iodic acid or with either of the strong mineral acids: *but as this alkaloid* generally contains brucia, nitric acid *reddens it.*

2. Dissolved in sulphuric acid no change ensues; but on adding a fragment of bichromate of potass to the solution a series of blue, violet, purple and red tints are produced. The same result is brought about by using ferricyanide of potassium, permanganate of potassium, the peroxide of lead, or the black oxide of manganese.

3. If the skin of a frog be dried, and a few drops of a solution containing strychnia applied to it, strong tetanic convulsions will ensue, and be reproduced every time the animal is touched or irritated. According to Dr. Marshall Hall this strychnoscopic test will detect the $\frac{1}{5000}$th of a grain, or even less.

4. An exceedingly useful class of tests for many poisons has been introduced by Dr. Guy; we mean the crystalline appearances presented on subliming the substance and condensing it on a cool microscopic slide, or the crystalline forms observed as modified by various reagents. Thus the strychnine sublimate, touched with a drop of carbazotic acid, forms groups of arborescent crystals, each branch forming part of a circle, when seen under the microscope.

CHAPTER XXIV.

HYPOSTHENISANTS.

NEUROTICS PRODUCING DEATH BY SYNCOPE.

ACONITE—PRUSSIC ACID.

ACONITE (*Aconitum Napellus, Monkshood, Wolfsbane, Blue Rocket*).—This beautiful plant is found in most parts of Europe.

Aconitia, the alkaloidal base of the plant, is the most deadly poison known; the fiftieth part of a grain having nearly caused death.

The chief *symptoms* of poisoning by aconite are numbness and tingling in the mouth and throat, giddiness, abolition of muscular power, pain in the abdomen, with vomiting and purging. Sometimes delirium and slight stupor have been noticed. The pupils are usually dilated, the skin is cold, the pulse exceedingly feeble, the breathing oppressed, and there is a dread of approaching dissolution. Frequently the sufferer is perfectly conscious, though paralysed, till death suddenly occurs after two or three hurried gasps. According to Dr. Fleming, death may be due to a sedative impression on the nervous system, or to asphyxia from paralysis of the respiratory muscles, or to *syncope*.

A fatal mistake is not very uncommonly made in eating *the root of aconite* for that of horseradish. The sense of *tingling* and numbness produced by the former is so *different from* the pungent taste of the latter that with due

care no mistake should occur, except the plants be allowed to grow together, which should never be done.

A case occurred in Ireland where a woman poisoned one man and nearly killed another by sprinkling powdered aconite root over a dish of greens.

Of the root one drachm, of the tincture one drachm, and of the alcoholic extract four grains, have caused death. Death follows a considerable dose in less than an hour, but sometimes a longer period elapses.

The Bikh poison, formerly much used in India, and still not unfrequently employed, has as its basis the Aconitum ferox, a still more dangerous drug than our indigenous plant.

Treatment.—No time must be lost in the use of remedies. In addition to emetics, castor oil, and animal charcoal, benefit may be derived from administering strong coffee. Brandy or ammonia should also be given, while the limbs and back are well rubbed with hot towels. Artificial respiration might prove useful.

There is no good test for aconitia.

HYDROCYANIC ACID (*Prussic Acid*), on account of its energetic and rapid action, is one of the most formidable poisons with which we are acquainted. In its concentrated state it is a limpid colourless liquid; possessing a somewhat acrid taste, and having an odour, when diffused through the air, resembling that of oil of bitter almonds. When diluted with water, it forms the acid kept by the druggist. The properties of this variety are similar to those of the pure form; except that, if kept in the dark, it is not so readily decomposed. It is in this condition that it is used as a poison. The diluted acid of the British *Pharmacopœia* contains about 2 per cent., and that known as *Scheele's* from 4 to 5 per cent., of the strong acid; but *all vary greatly with keeping.*

One of the salts of hydrocyanic acid, the *cyanide of potassium*, claims a short notice, since it is largely employed by photographers, workers in electrotype, &c. It has been taken as a poison. This salt is sold in the form of deliquescent white crystals, or in crystalline masses, which are very soluble in water, and possess the odour of prussic acid. From three to five grains will destroy life almost as rapidly as prussic acid itself, and in the same manner: a dose of five grains has proved fatal.

Several vegetable substances yield prussic acid, such as the kernels of the peach, apricot, nectarine, cherry, &c., the leaves of the cherry laurel, and the pips of apples and pears. Cases of alarming illness have occurred from eating *bitter almonds* too freely; while the essential oil obtained by distilling the pulp of these almonds with water is a powerful poison. This *essence* or *oil of bitter almonds* contains about ten per cent. of anhydrous prussic acid; and it is probable that from ten to thirty drops would prove fatal to an adult. The prussic acid may, however, be separated from it, and leave the oil harmless.

A distilled water obtained from the leaves of the cherry laurel, which was formerly employed in medicine, proved dangerous from its very variable strength; it has been used as a poison. In the well-known case of Sir Theodosius Boughton, poisoned by Captain Donellan in 1781, *laurel water* produced death within half an hour after two ounces had been swallowed.

The smallest quantity of prussic acid which has been known to destroy life is nine-tenths of a grain of the anhydrous acid, equal to forty-five minims of the diluted preparation of the British Pharmacopœia; and it is probable that this would, in most instances, prove fatal. In the case referred to death occurred in twenty minutes;

but from a larger dose it has ensued much earlier. The period may be said to vary from two to five and forty minutes. Insensibility may, however, come on in a few seconds. In the case of seven epileptics accidentally poisoned at the Bicêtre, death occurred in the first within twenty minutes, in the last after three-quarters of an hour, though the dose of the acid was the same in each instance.

Symptoms.—These will vary with the dose and the mode of exhibition. Inhalation of the vapour of anhydrous prussic acid would immediately cause death. The vapour of the diluted acid has given rise to serious symptoms with great rapidity. Scheele is said to have been suddenly killed by respiring the vapour of the dilute acid while making his experiments.

When the diluted acid is taken in a large dose the symptoms may commence during swallowing, death following so quickly that scarcely any effects can be observed. The chief symptoms, perhaps, are insensibility, slow gasping, or convulsive respiration, a clammy cold skin, fixed and glistening eyes, dilated pupils, spasmodic closure of the jaws, an almost imperceptible pulse, and sometimes convulsions of the limbs and trunk. The rapidity with which consciousness is lost is well exemplified in an instance recorded by Hufeland, where a man about to be apprehended as a thief took an ounce of the acid, staggered a few steps and fell apparently lifeless. In a few moments a single violent inspiration was made, and within five minutes of taking the poison he was dead.

Insensibility is not, however, in all instances, immediately produced; many an authenticated case having occurred in which the symptoms were protracted for some minutes, the individual performing several acts indicating

consciousness, such as replacing the cork in the bottle, adjusting the bed-clothes, or even running some distance to summon help.

The utterance of a shriek has been said to be characteristic of poisoning by this acid; but toxicologists know that such has not been observed in the human subject, and that there is merely a gasping for breath, or perhaps a call for help.

A small dose produces faintness, insensibility, difficulty of breathing, involuntary evacuations, loss of muscular power, convulsions, and temporary paralysis. If the proper treatment be employed, recovery may often be effected.

Post-mortem Appearances.—The body is generally livid, the countenance pallid, or sometimes livid and bloated, the jaws firmly closed, and the hands clenched. There is frequently blood or froth about the mouth, and the eyes are sometimes described as prominent and glistening. There is often an odour of prussic acid about the body, which is more perceptible on opening the stomach. The venous system is usually gorged with blood; and the brain, lungs, heart, liver, spleen, and kidneys have been found congested with dark-coloured fluid blood.

Treatment.—There is no chemical antidote to this poison which can be relied upon. Chlorine and the mixed oxides of iron have been recommended; but even if one of these agents happened to be at hand, it is doubtful if its employment could be timely enough to be advantageous. Attempts must be made to restore animation by cold affusion, stimulating frictions to the chest and abdomen, *warmth* to the surface, and the application of ammonia to *the nostrils. Cold* affusion over the head and neck has *proved most efficacious* when promptly resorted to, and

repeated at short intervals so as to cause a shock. The direct injection of liquor ammoniæ into the veins, as proposed by Professor Halford, for snake bite, might be tried if the means were at hand. As soon as possible ammonia should be given internally and the stomach emptied.

If recovery ensue from the immediate effects, vomiting should be produced by emetics or otherwise; after which strong coffee, with brandy, ought to be administered.

Tests.—The best are the following:

When hydrocyanic acid has to be separated from organic substances, such as the contents of the stomach, it is usual to take advantage of its ready volatility. If the acid be not in combination it may be given off so readily as to be detected by a watch glass moistened with nitrate of silver held over the vessel containing the acid; but in order to make sure of its presence or absence the following process should be adopted. The suspected material should be acidulated with pure sulphuric acid so as to insure the prussic acid being in a free state. The substances thus acidulated are to be placed in a retort, destilled over a water bath, and the destillate collected in a cool receiver containing some caustic potass. About one-sixth of the fluid substance should in this way be destilled over, when the liquid in the receiver may be tested by the silver or iron tests, or the vapour as it passes over may be tried with the sulphur test.

1. The peculiar *odour* of prussic acid is well known, and is a very delicate test, taken in conjunction with others, of its presence.

2. *The Silver Test.*—Nitrate of silver yields, with hydrocyanic acid or cyanide of potassium, a white clotted precipitate, (cyanide of silver,) insoluble in cold but soluble in boiling nitric acid. If this precipitate be well dried

ad to this is to be added a [illegible]
alphate of iron. A dirty brownish or greenish pr
rill fall, consisting of a mixture of the oxide of
russian blue. On adding a few drops of diluted s
r hydrochloric acid, and thus dissolving the ox
prussian blue will immediately be made clear if hy
acid be present.

4. *The Copper Test.*—Sulphate of copper
prussic acid rendered slightly alkaline by potass
greenish-white precipitate, which becomes whit
addition of a few drops of hydrochloric acid to di
blue precipitated oxide of copper.

5. *The Sulphur Test.*—One of the most usefu
prussic acid, whether in the fluid or volatile st
so-called sulphur or Liebig's test. It is best a
detecting the acid in a state of vapour, and to
drop of yellow sulphide of ammonium in a wat
[illegible] may l

is then added as before, but all the sulphide must be decomposed or a black sulphide of iron will be produced, even though prussic acid be present, instead of the ordinary blood-red colour.

Other substances give a similar reaction with iron; but their colour is discharged by corrosive sublimate.

CHAPTER XXV.

DEPRESSANTS.

NEUROTICS PRODUCING MARKED DEPRESSION OF THE HEART'S ACTION.

DIGITALIS—CALABAR BEAN—TOBACCO—HEMLOCK.

DIGITALIS PURPUREA (*Purple Foxglove*).—The seeds, leaves, and root of this indigenous hedge-plant are poisonous. *Digitalin* is the principle which these parts contain. The officinal infusion of digitalis, made from the dried leaves, is used in doses of ʒij, ℥ss, or more; of the tincture m. v to m. xl are usually given. On the recommendation of the late Mr. Jones, of Jersey, half an ounce of the tincture is sometimes administered in cases of delirium tremens; this dose being repeated a second or even a third time, in the course of six or eight hours.

Digitalis is very uncertain in its action. When given medicinally its effects should be watched, as in some cases it probably accumulates in the system, but in others, especially in heart disease, it may be given for months or years without hurt, and even with advantage. A poisonous dose seems to produce vomiting, purging, colic, headache, slowness and extreme irregularity of pulse, dimness of vision, dilated pupils, lethargy, prostration, convulsions, and coma. In two instances death occurred within twenty-*two* hours. The appearances found afterwards have been *chiefly congestion* of the cerebral vessels and slight inflam*mation of the stomach.*

Digitalin has acquired a certain importance from the trial and execution of De La Pommerais for poisoning the widow Pauw by its means. The facts were altogether inconsistent with his innocence, and though digitaline was not separated from the woman's body, yet extracts of the vomited matters killed dogs with the symptoms of poisoning by digitalis. The extracts obtained from the stomach and bowels did not prove fatal. Tardieu and Roussin, who were engaged on the case, came to the conclusion that the woman had been poisoned by some vegetable poison, probably digitaline. The woman's symptoms, which were not, however, carefully noted, were violent vomiting and extreme depression.

In addition to the administration of emetics and castor oil, some infusion containing tannin, as strong tea, &c., should be given as an antidote in poisoning by digitalis. Substances containing tannin render the digitalin inert. Strong tea or coffee, with brandy, will likewise be needed, to lessen the depression and exhaustion.

CALABAR BEAN (*Physostigma venenosum*).—This bean, which grows on the West Coast of Africa, is generally used as an ordeal. According to the superstition of the natives the innocent vomit and are safe, the guilty die. Its most characteristic effect is contraction of the pupil. It seems to act by paralysing the motor muscles, leaving the senses intact. There is great interference with the heart's action, it beating tumultuously, but death seems to follow paralysis of the muscles of respiration. In some cases, one fatal, occurring in Liverpool, there was much vomiting.

TOBACCO (*Nicotiana tabacum*).—All parts of this plant are very poisonous. An infusion of the leaves, exhibited as an enema, has, on several occasions, speedily proved fatal. Persons in attempting to acquire the habit of smoking often

suffer from severe nausea, vomiting, great prostration, and insensibility; while in some instances, more severe effects have ensued. Symptoms very much resembling those of apoplexy have also been produced by the excessive use of snuff. A celebrated French poet died in fourteen hours, from swallowing the contents of his snuff-box, which had been mixed with his wine, as a joke. Snuff or tobacco is also sometimes used for drugging persons with a view to nefarious purposes, as robbery and such like.

Nicotin, the alkaloid of tobacco, is as deadly a poison as prussic acid. It is an acrid, volatile, oily liquid, of a pale amber colour. In 1858 a chemist of rising reputation committed suicide with this substance. He was seen by one of the attendants at the Museum in Jermyn Street, in the act of falling forwards out of a water-closet in which he had concealed himself. The attendant raised him up, and with the aid of another man endeavoured to carry him to a table, but he heaved a deep sigh and died in their arms. The appearances afterwards found were great congestion of the membranes of the brain and a dark fluid state of the blood.

The only other case of importance on record was the occasion of the *cause célèbre* Bocarmé. This man, a Belgian count, studied chemistry, apparently, with a view to the preparation of this substance, made it in quantity, and with the help of his wife poisoned her brother. The count was condemned and executed. M. Stas was engaged to search for the poison, and thus was introduced his process, so often *referred to.*

CONIUM *(Conium maculatum,* Common or *Spotted Hemlock).*—*This* indigenous plant, which grows abundantly *in hedges and wild* places, belongs to the order Umbelliferæ. *The following* common umbelliferous plants are likewise

poisonous: viz., the *Cicuta virosa* or water-hemlock, the roots of which have been eaten in mistake for parsnips; the *Œnanthe crocata*, or the water-dropwort, one of the most virulent of English vegetables; the *Æthusa cynapium*, or fool's parsley, sometimes gathered in mistake for parsley; and the *Phellandrium aquaticum*, or fine-leaved water-hemlock, popularly known as water-parsnip. They have all given rise to accidents.

The seeds, leaves, and root of the *Conium maculatum* are all poisonous. The effects are rather variable, sometimes consisting chiefly of delirium, stupor, coma, and convulsions; on other occasions, the action, being chiefly exerted on the spinal cord, gives rise to gradually extending paralysis, the lower limbs being first affected, afterwards the arms and chest, thus producing death by apnœa from paralysis of the muscles of respiration. Probably, however, could artificial respiration be kept up, the heart would continue to beat much longer.

The alkaloid of hemlock is a pale yellow, volatile, acrid, oily-looking liquid, known as *conia*, *conein*, or *conicina*. It is a potent poison, occasioning general paralysis without loss of sensibility. This alkaloid, which is found in all parts of the plant, may be readily recognised by rubbing with caustic potass. This sets free the alkaloid from its combination, and being readily volatile its mouse-like odour becomes at once apparent. Chemically it is allied to ammonia, and gives many of the reactions of that substance.

In many respects *curare* (referred to under *Nux vomica*) acts similarly to *conia*.

LOBELIA INFLATA (*Indian Tobacco*).—This plant is a native of North America; and its powdered leaves and seeds have been much used as a remedy for asthma. In one instance, in which a quack prescribed a drachm of t

leaves, pain, vomiting, unconsciousness, feebleness of pulse, and contraction of the pupils supervened, and death occurred in thirty-six hours. Ignorant impostors, calling themselves "medical botanists" (more appropriately known as "Coffinites"), have poisoned several simple individuals, both in England and America, by physicking them with this mischievous and powerful drug.

COLCHICUM (*Colchicum autumnale, Meadow Saffron*).—This plant grows in most damp meadows. Its noxious properties are due to the active principle *Colchicia*, which in its effects is allied to that contained in white hellebore, *Veratria*. In two instances less than half a grain of colchicia proved fatal to adults.

White Hellebore (*Veratum album*) is a poisonous plant which, when taken internally, has caused violent sickness, purging, dilatation of the pupils, great prostration, and lowering of the heart's action, cold sweats, convulsions, and death. At the same time it is powerful in relieving pain. Its properties are due to *veratria*, an alkaloid, which may also be prepared from the seeds of the Asagræa officinalis, or Cevadilla seeds, and from Veratrum viride.

Gentle emetics, purgatives, and stimulants are the means employed to prevent death in poisoning by any of these vegetable substances. They all produce extreme depression, hence stimulants must be freely used.

CHAPTER XXVI.

ASPHYXIANTS.

NOXIOUS GASES, PRODUCING NEUROTIC SYMPTOMS.

THE most important of these asphyxiant noxious gases are carbonic oxide, carbonic acid, sulphuretted hydrogen, and carburetted hydrogen.

CARBONIC OXIDE is a much more dangerous poison than is carbonic acid, but poisoning with it in a pure state is rare. It constitutes an ingredient in most vapours produced by burning coke or carbon, especially if the combustion is imperfect. It forms with the colouring matter of the blood a remarkably stable compound of a light red colour; in point of fact it is the impossibility of exchanging carbonic acid for oxygen in the lungs which causes death. After death the blood is bright red in hue.

CARBONIC ACID GAS.—This heavy inodorous gas is the cause of numerous accidents, owing to the variety of sources from which it is produced. It is formed from burning fuel, from the calcination of limestone or chalk, and it is a product of respiration. It is diffused through wells, coal-mines, and caverns. During fermentation it is largely given off, and accumulates in beer vats. The vapour of charcoal partly owes its poisonous properties to carbonic acid gas, as does that arising from lime and brick-kilns.

In this country suicides rarely resort to carbonic acid gas *to accomplish* their ends: in France they very frequently *do so.*

Symptoms.—In its pure state this gas causes death by asphyxia, the glottis becoming spasmodically closed the moment the vapour comes in contact with it. When sufficiently diluted to be inspired it acts by absorption, giving rise to giddiness, headache, vomiting, a tendency to sleep, and loss of muscular power. The heat of the body continues, and the limbs are usually flexible. The countenance gets livid, the respiration becomes hurried and stertorous, and complete insensibility ensues; while the heart's action, which was at first rapid, soon ceases.

Post-mortem Appearances.—The body is generally swollen and livid, especially about the face. The countenance is not always bloated, sometimes being calm and pale. The limbs are often rigid, the skin is marked with livid patches, and the abdomen is distended with gas. The right cavities of the heart, the lungs, and large veins, are found gorged with venous blood; while the brain and its membranes are usually very vascular, and occasionally there is serous effusion.

Treatment.—Prompt removal to the pure air, cold affusion, and stimulating applications to the chest and extremities, are the best means for resuscitation. If the countenance is bloated, venesection may be performed. Artificial respiration, galvanism, and the inhalation of oxygen gas, have been found useful.

SULPHURETTED HYDROGEN.—This gas is a very active poison, but from its offensive odour (resembling that of rotten eggs) it is not so liable to be accidentally inhaled as is carbonic acid. It is usually met with combined with other gases, resulting from the putrefaction of animal matter. When breathed in a diluted state, it speedily produces *insensibility* and death. Workmen long engaged in *drains and sewers*, or in any atmosphere contaminated with

sulphuretted hydrogen gas, suffer from giddiness, nausea, and weakness; these symptoms ending at length in a kind of fever, which is often fatal.

In acute cases there will be little hope of recovery, unless the individual can be quickly removed into the open air, and stimulants, &c., applied. Chlorine gas, well diluted with common air, might be employed, as it breaks up the gas.

CARBURETTED HYDROGEN (*Coal Gas*).—The symptoms produced by this gas, when mixed with air and inhaled, are those of asphyxia. If the person breathing it should be roused before a fatal quantity has been inhaled, the chief effects may be intense headache, laboured and oppressed respiration, quickened action of the heart, sickness, and great loss of power.

In 1841 a family in Strasburg were poisoned by being in an atmosphere contaminated with coal gas, for forty hours. Of the six members, four were found dead, while the father died in twenty-four hours; but the mother recovered. The gas escaped from a pipe which passed under the cellar of the house where this family resided; so that it probably poisoned the air gradually, and gave rise to no suffering to warn the unfortunates.

CHAPTER XXVII.

ABORTIVES.

SUBSTANCES PRODUCING ABORTION.

THIS group, though far from a natural one, is nevertheless convenient. It comprehends a great variety of substances, first among which comes

ERGOT OF RYE (*Spurred Rye, Secale cornutum*).—The grain of wheat, barley, oats, and rye is apt to be attacked by a parasitic fungus which imparts to it specific properties. This substance has the power of inducing contraction of unstriped muscular fibre, especially in the smaller arteries and uterus. Ergotised grain, in full doses, gives rise to lassitude, headache, nausea, and diarrhœa. From small quantities, frequently repeated, gangrene of the extremities has resulted. The peculiar influence of ergot on the muscular coat of the uterus renders this agent a valuable medicine when we wish to induce powerful contractions, but in the hands of the ill-intentioned it is frequently used to procure abortion; but its action in this way is far from certain, and at all times dangerous.

Savin and its oil are irritant poisons, only indirectly affecting the uterus; nevertheless, they not unfrequently are used to induce miscarriage.

Oil of Tansy has also been employed in America as an abortive agent, and in three instances, at least, has caused death.

The Yew (*Taxus baccata*), which has acquired in certain districts a reputation as an abortive, acts as do some others, by producing irritation of the bowels, and so communicating a kind of stimulus to the uterus. The leaves and berries of the yew have both proved fatal, commonly with irritant symptoms; but those of coma have also been observed.

In America extract of Cotton-wood has a reputation as an abortive.

APPENDIX.

I. BITES OF VENOMOUS REPTILES.—The poisonous reptiles provided with fangs are the Ophidia, or Serpents.

Accidents from serpents' bites rarely, of course, happen in this country, but are of frequent occurrence in India, Australia, and America.

On the morning of the 20th October, 1852, one of the keepers at the Zoological Gardens in the Regent's Park, was wounded by a cobra, which he had removed from its cage and was playing with. For twenty minutes after the animal bit him at the root of the nose no peculiar symptoms were manifested, and the part was merely bathed with water. Forty minutes afterwards the man was admitted into University College Hospital, his face then being livid, respiration impeded, and the power of locomotion imperfect. He pointed to his throat as the seat of pain, but could not speak, and was unable to swallow. Artificial respiration was employed for fifty minutes, and subsequently galvanism; but stupor rapidly succeeded to faintness, and the patient died comatose fifty-five minutes after admission. The chief appearances found on dissection were an unnatural fluidity and blackness of the blood, with great congestion of the lungs and *spleen.*

The only poisonous reptile indigenous to this country *is the common viper* or *adder.* It is found on the heaths *and in the dry woods* of all parts of England, Scotland,

and Wales, and is much feared on account of its venom. Very few cases are known in which the bite of this animal has proved fatal. In May, 1862, a little boy, at Burgess Hill, near Brighton, clambered up a bank, to examine a bird's nest. Groping with his hand among the moss, he felt, as he thought, a sharp prick from a thorn. It turned out to be a bite from an adder. As the real cause of the wound was not suspected, the swelling of the hand and arm was not properly attended to until too late, and the poor child died on the second day.

The poison apparatus of the viper consists of a gland placed by the side of the head, a duct, and a fang or pointed curved tooth, moulded in the form of a tube on either side. On being bitten, the person has pain in the wounded part, which quickly becomes severe and extends up the adjoining tissues. The limb swells greatly, becomes red and livid; while faintness soon sets in, and the pulse gets rapid and small. Bilious vomitings, dyspnœa, profuse cold sweats, jaundice, delirium, and convulsions, have also been noticed. In a few days the symptoms usually amend; but in weak sickly individuals gangrene of the limb may follow, or death may occur in the course of two or three days.

The *treatment* of the bites of venomous reptiles must be local and constitutional. Immediately the wound is inflicted it should be sucked freely and perseveringly. If the patient is too faint to do this for himself, a bystander may fearlessly help him; for it is well known that these poisons may be smeared upon the lips and tongue, or even swallowed, with impunity. At the same time a ligature *is to be placed* around the limb, above the wound; or if *this be impossible*, from its situation, the textures around *are to be* compressed. Then, the bitten part may be

excised; or it may be destroyed by the actual cautery, nitric acid, the strong liquor ammoniæ, or nitrate of silver.

Professor Halford, of the University of Melbourne, in a paper published at the commencement of 1869, recommended the injection of liquor ammoniæ into the veins for snake-bite. Of twenty cases of snake bite since treated in this manner, by different practitioners, recovery occurred in seventeen. The snakes were all venomous, and included the tiger-snake, the brown and black snake of Australia, &c. These, according to Professor Halford, are as deadly as the cobra and rattlesnakes of India. The plan of proceeding is to expose the vein, and then to pierce its coats with the sharp point of a hypodermic syringe containing the officinal liquor ammoniæ—sp. grav. 0·959. At least thirty minims are to be employed; the dose being repeated as the power of the preceding injection is expended. Professor Halford formerly thought that in consequence of the entrance of the snake poison into the blood a rapid growth of new cells occurred, which took up and exhausted the fibrin and oxygen of the blood, and rendered them incapable of ministering to the wants of the system. He now thinks that the new corpuscles are only the white corpuscles of the blood altered and enlarged, the change in them being caused by an alteration in the liquor sanguinis; this alteration being, in fact, a disappearance of the fibrin under the action of the poison. The ammonia is believed to counteract this power, and in favour of this view many Australian physicians have spoken strongly. Dr. Fayrer, however, has found the proceeding a failure in India. This gentleman is of opinion that the activity of the poison in some Indian snakes is so great that it is impossible to counteract it by any method.

The constitutional remedies are derived chiefly from the class of diffusible stimulants. No agent is more generally recommended than ammonia; and therefore the officinal compound tincture of ammonia (formerly known as eau de luce) should be given in half-drachm doses, well diluted; or the aromatic spirits of ammonia may be administered in the proportion of two drachms to an ounce and a half of water. Supposing that no ammonia is at hand, brandy will prove an excellent substitute. Transfusion of blood has been likewise recommended; but I do not know of any instance in which it has been resorted to.

II. Bites of Rabid Animals.—As the subject of Hydrophobia is fully treated of in Dr. Tanner's work on 'The Practice of Medicine,' remarks are here confined to the treatment to be adopted directly a person is bitten by a rabid animal. This is briefly as follows:—The tissues round the seat of injury are to be compressed by a ligature or otherwise, to prevent absorption. Then the wounded part is to be excised as soon as possible; taking care to remove every portion touched by the animal's teeth, and to obtain a clean raw surface. The wound should then be thoroughly washed by a stream of water, long poured over it, and lunar caustic afterwards applied. Mr. Youatt prefers the nitrate of silver, freely used, to every other caustic; and he also recommends that after its application the wound should be quickly healed, though many authorities advise that it be kept open by irritating ointments. As these operations are very painful, there is no objection to the patient being placed under the influence of chloroform. He should afterwards be assured that everything has been *done to prevent* any subsequent mischief; and to give him *greater confidence* and to banish all fear from his mind, it

may be as well to administer ammonia and bark for some days after the accident.

III. STINGS OF BEES, ETC.—The poison apparatus of the common bee consists of glands, and a sting placed at the extremity of the body. The effect of the bite is usually slight, and the pain quickly passes off. In some few instances, however, there have resulted swelling and erysipelas, or suppuration and gangrene, or even death.

In the month of August, 1819, John Trevalli, of Pennsylvania, was stung by a bee in the middle finger of his right hand. He immediately became faint and insensible to surrounding objects; his complexion was livid, his breathing slow, and the perspiration saturated his clothes. At the end of an hour and a half he was bled, and recovered. On the 21st July, 1820, he was stung in the temple by a humble bee. His wife was present and gave him some water, but in ten minutes he was dead.—(*American Journal of Medical Sciences*, Vol. 19, p. 265. Philadelphia, 1836.) Two other rapidly fatal cases are noticed in the same journal, as well as two examples of death from the sting of a wasp and one from the bite of a spider.

Mr. C. Hanbury has recorded a case of death from the sting of a bee (*Medical Times and Gazette*, p. 232. 10th March, 1860); and has also given short abstracts of several examples collected by Dr. Crisp, where severe symptoms have resulted from the same injury. Sir Benjamin Brodie (*Lectures on Pathology and Surgery*, p. 286. London, 1846) says he has seen a case in which sloughing of the cellular tissue followed from a leech bite, and another in which similar mischief followed the sting of a bee. Both the patients died.

And again, in a communication from Montbard (La

Patrie, 19th September, 1858) it is stated that a youth sixteen years of age was drinking from a bottle, when a wasp, which he had not seen, got into his throat and wounded him. He died suffocated by the swelling, before any assistance could be procured.

According to Messrs. Kirby and Spence (*Introduction to Entomology*, Seventh Edition, p. 76, London, 1856), serious effects are sometimes produced on peculiar constitutions by eating freely of honey or from partaking of mead—a drink made by fermenting honey and water. These authors state that they knew a lady upon whom such things acted like poison, and they had heard of instances in which death was the consequence. Sometimes, when the bees have extracted their sweets from poisonous plants, these injurious results have not been confined to individuals of a particular habit. Thus, according to Dr. Barton (*American Philosophical Transactions*, vol. 5), there were numerous deaths in the autumn and winter of 1790 from eating honey collected in the neighbourhood of Philadelphia, which, on inquiry, was found to be due to this substance having been extracted from the beautiful but poisonous flowers of the Kalmia latifolia.

The following Table from Dr. Garrod's 'Materia Medica' shows the proportions in which some of the more important drugs of the 'Pharmacopœia' are contained in the Officinal Preparations.

ANTIMONY.

(Tartar Emetic.)

$\frac{1}{4}$ gr. of tartarated antimony is contained in 1 fl. drm. of vinum antimoniale.

1 gr. of tartarated antimyny is contained in 5 gr. of unguentum antimonii tartarati.

(Oxide of Antimony.)

1 gr. of oxide of antimony is contained in 3 gr. of pulvis antimonialis.

ARSENIC.

(Arsenious Acid, White Arsenic.)

$\frac{1}{24}$ gr. of arsenious acid is contained in 5 min. of liquor arsenicalis.

$\frac{1}{21}$ gr. of arsenious acid is contained in 5 min. of liquor arsenici hydrochloricus.

(Arseniate of Soda.)

$\frac{1}{21}$ gr. of arseniate of soda (dried) is contained in 5 min. of liquor sodæ arseniatis.

MERCURY.

(Metallic.)

1 gr. of mercury is contained in 3 gr. of hydrargyrum cum cretâ.

1 gr. of mercury is contained in 3 gr. of pilula hydrargyri.

1 gr. of mercury is contained in 2 gr. of unguentum hydrargyri.

(HYDRARGYRI PERCHLORIDUM.)

$\frac{1}{10}$ gr. of perchloride of mercury is contained in 1 fl. drm. of liquor hydrargyri perchloridi.

(HYDRARGYRI SUBCHLORIDUM, or CALOMEL.)

1 gr. of subchloride of mercury (calomel) is contained in 5 gr. of pilula hydrargyri subchloridi composita.

1 gr. of subchloride of mercury (calomel) is contained in about 6½ gr. of unguentum hydrargyri subchloridi.

ACONITE.

1 gr. of dried aconite root is contained in about 9 min. of tinctura aconiti.

ACONITIA.

8 gr. of aconitia are contained in 1 oz. of unguentum aconitiæ.

ATROPIA.

1 gr. of atropia is contained in 2 fl. drm. of liquor atropiæ.

1 gr. of sulphate of atropia in 2 fl. drm. of liquor atropiæ sulphatis.

8 gr. of atropia are contained in 1 oz. of unguentum atropiæ.

BELLADONNA.

1 gr. of dried belladonna is contained in about 22 min. of tinctura belladonnæ.

Each fluid part of linimentum belladonnæ contains the active portion of a solid part of the dried root.

CANNABIS INDICA.

1 gr. of alcoholic extract of Indian hemp is contained in about 22 min. of tinctura cannabis Indicæ.

CANTHARIDES.

1 gr. of cantharides is contained in about 88 min. of tinctura cantharidis.

COLCHICUM.

1 gr. of dried corm of colchicum is contained in about 5½ min. of vinum colchici.

1 gr. of colchicum seeds is contained in about 9 min. of tinctura colchici.

DIGITALIS.

1 gr. of dried leaves of digitalis is contained in about 9 min. of tinctura digitalis.

HEMLOCK.

1 gr. of hemlock fruit is contained in about 9 min. of tinctura conii.

IPECACUANHA.

1 gr. of ipecacuanha root is contained in about 22 min. of vinum ipecacuanhæ.

1 gr. of ipecacuanha root is contained in *twelve* morphia and ipecacuanha lozenges.

1 gr. of ipecacuanha root is contained in 4 ipecacuanha *lozenges.*

NUX VOMICA.

1 gr. of *nux vomica* seed is contained in about 11 min. of *tinctura nucis* vomicæ.

(STRYCHNIA.)

1 gr. of strychnia is contained in 2 fl. drm. of liquor strychniæ.

OPIUM.

(ACETATE OF MORPHIA.)

¼ gr. of acetate of morphia is contained in 30 min. of liquor morphiæ acetatis.

(HYDROCHLORATE OF MORPHIA.)

¼ gr. of hydrochlorate of morphia is contained in 30 min. of liquor morphiæ hydrochloratis.

¼ gr. of hydrochlorate of morphia is contained in *nine* morphia lozenges.

¼ gr. of hydrochlorate of morphia is contained in *nine* morphia and ipecacuanha lozenges.

½ grain of hydrochlorate of morphia is contained in *each* morphia suppository.

(OPIUM DRIED SUFFICIENTLY TO BE POWDERED.)

1 gr. of opium is contained in 14½ min. of tinctura opii.

1 gr. of opium is contained in 14½ min. of vinum opii.

1 gr. of opium is contained in ½ fl. oz. of tinctura camphoræ composita.

1 gr. of opium is contained in 96 min. of tinctura opii ammoniata.

1 gr. of opium is contained in 1 fl. oz. of enema opii.

1 gr. of opium is contained in 5 gr. of pilula saponis composita.

1 gr. of opium is contained in 8 gr. of pilula plumbi cum opio.

1 gr. of opium is contained in 10 gr. of pulvis ipecacuanhæ compositus.

1 gr. of opium is contained in 20 gr. of pulvis kino compositus.
1 gr. of opium is contained in 40 gr. of pulvis cretæ aromaticus cum opio.
1 gr. of opium is contained in 10 gr. of pulvis opii compositus.
1 gr. of opium is contained in about 13½ gr. of unguentum gallæ cum opio.
1 gr. of opium is contained in *ten* opium lozenges.
1 gr. of opium equals about ½ gr. of extractum opii.
1 gr. of extract of opium is contained in 22 min. of extractum opii liquidum.

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